ELECTRONICS for BEGINNERS

JOE HARVEY FERNANDEZ ALEGADO

REX BOOK STORE, INC.

premier12

Urheberrechtlich geschütztes Material

VISIT…

RBS
Electronic for Beginners
First Edition 1998
ISBN 971-23-2262-9
Classification: *Textbook*
Printed February 1999

Published, copyrighted 1998 and distributed by REX **Book Store, Inc.** (RBSI) with main office at 856 Nicanor Reyes, Sr. St., Sampaloc, Manila; Tels. 741-49-16, 735-13-64
Regional Offices: Sanciangko St., Cebu City, Tels. 760-63, 771-29; 156-A C.M. Recto St., Davao City, Tel. 221-02-72; 2nd St., Ledesco Village, Jaro, Iloilo City.

No portion of this book may be copied or reproduced in books, pamphlets, outlines, or notes, whether printed, mimeographed, typewritten, photocopied, or in any other form, for distribution or sale, without the written permission of the Publisher and authors. The infringer shall be prosecuted in compliance with the copyright, trademark, patent, and other pertinent laws.

RBSI's Local Book Associations Membership: Association of Philippine Booksellers (APB); Book Development Association of the Philippines (BDAP); Philippine Educational Publishers Association (PEPA)

PEPA's International Book Associations Membership: Asian Pacific Publishers Association (APPA); Association of South East Asian Publishers (ASEAP); International Publishers Association (IPA)

Printed by REX PRINTING COMPANY, INC. 84-86 P. Florentino St., Sta. Mesa Heights, Quezon City, Tels. 712-41-08, 712-41-01; Fax no. 711-54-12

Urheberrechtlich geschütztes Material

premier12

Table of Contents

Part One

VOM 1

- The Function of Its Parts 2
- Tips for the Proper Use of the VOM 2
- Types of Meters 3
- Test Measurement 11

Part Two

Basic Electronics 14

- Electronic Components and Symbols 18
- Resistor Color Coding 20
- Actual Resistance Measurement 22
- Troubles in Resistors 22
- Series and Parallel Connection 23
- Ohmmeter Checking 24
- Continuity Checking 25
- Condition of the Wire 25
- Speaker Checking 26
- Capacitor 27
- Checking of Capacitors 27
- Checking of Non-polar Capacitor 30
- Troubles in Capacitor 31
- Checking of the Diode 33
- Transformer Classification 39

Part Three

AC/DC Converter Power Supply 40

- The Function of Its Parts 40

Urheberrechtlich geschütztes Material

Theory 41
Voltage Test Points 43
Types of Power Supply 44
Troubleshooting Tips 45
Wiring Installation and Parts 45

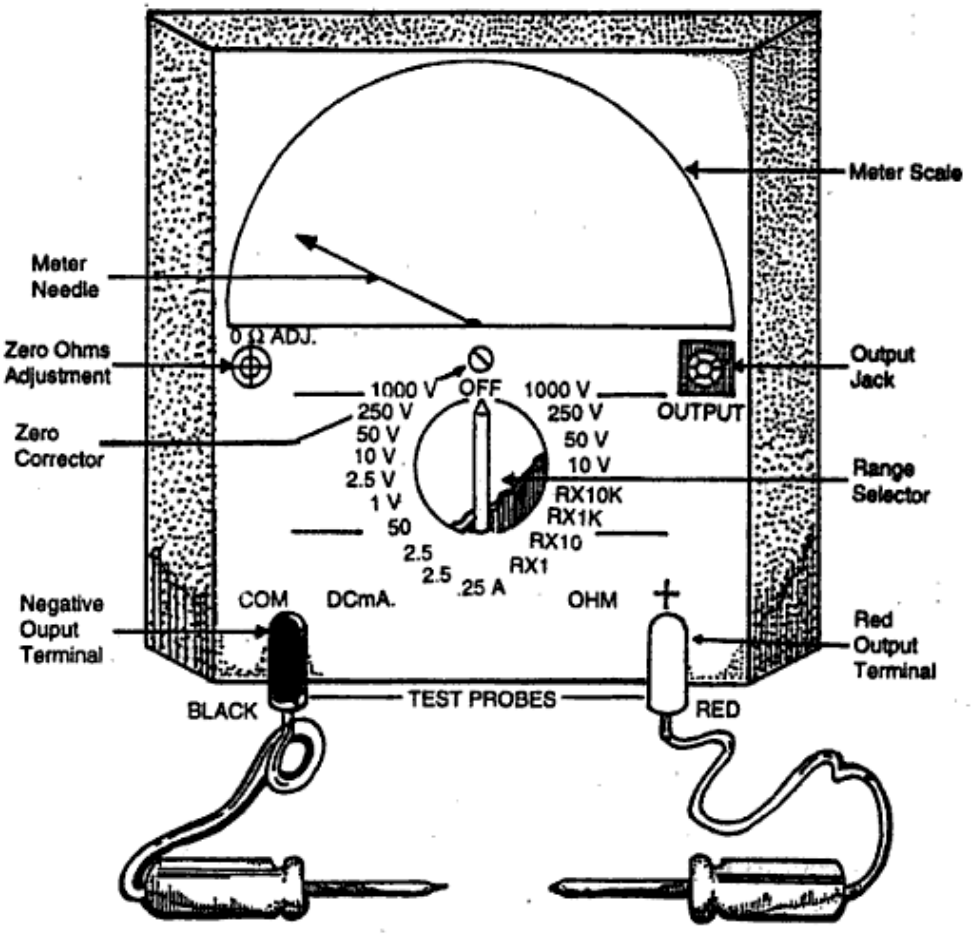
Urheberrechtlich geschütztes Material

VOM

Objectives

This lesson covers the Familiarization of Parts and Functions of the VOM test instrument. The reader must review carefully and put into practice the measurement and testing components by using VOM.

PARTS OF VOM



Urheberrechtlich geschütztes Material

FUNCTION OF ITS PARTS

1. METER NEEDLE — It indicates the measured value on the meter. It is connected to a moving coil that requires extra care to avoid damage from the meter .

2. METER SCALE — This is the part where the quantity of measured value can be obtained.

3. ZERO OHM ADJUSTMENT — It is designed to calibrate ranges to be used in the Ohmmeter to obtain accurate reading. Calibration will be discussed on page 3.

4. NEEDLE CORRECTOR — This is an adjustment designed to place the pointer at zero label (to the left) before measuring the DC/AC voltage to obtain accurate reading.

5. OUTPUT TERMINAL — This is where the RED TEST PROBE is connected at the Positive terminal while the BLACK TEST PROBE is connected at the Negative terminal.

6. SELECTOR SWITCH — It is used to select the desired and proper range before doing any measurement.

7. TEST PROBES — It is that part of the VOM that is connected to the circuit undertest.

8. OUTPUT TERMINAL — It is used to measure the amount of an AC source and to block the DC source.

TIPS FOR THE PROPER USE OF THE VOM

1. Select first the PROPER RANGE before measuring electrical quantity and before checking the component. This system will ensure safety to your VOM.

Urheberrechtlich geschütztes Material

2. Start using the highest range if there is an unknown amount of quantity to be measured and gradually adjust it to lower range to avoid damage from the meter.

3. Observe properly the connection of polarity.

TYPES OF METERS

1. OHMMETER — This circuit is designed to measure resistance and check components. Be sure to turn off the unit before measuring resistance to avoid damage from the meter. Voltage is not necessary when using this meter.

Calibration Procedure

A. Select the proper range.

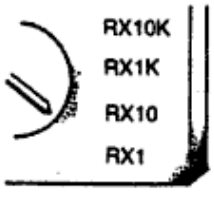
B. Connect or short the two test probes (pointer will deflect).

C. If the pointer does not fall to zero (to the right) then adjust the zero ohm adjustment and make sure that the pointer will rest at zero.

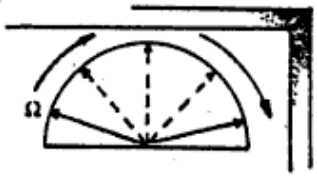
D. If it's done, then proceed to the measurement.

ILLUSTRATION

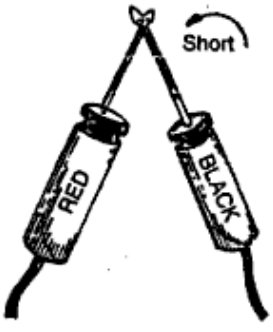
A.



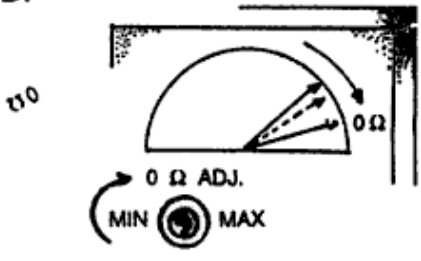
C.



B.



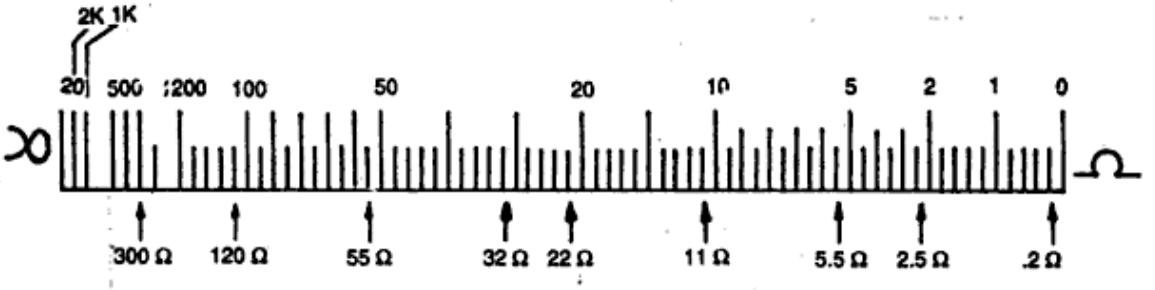
D.



Urheberrechtlich geschütztes Material

Note: If the zero ohm adjustment is set to maximum and the pointer does not fall to zero, then a suspected weak battery is to be replaced for proper operation.

READING OHMMETER SCALE



Measuring Resistance

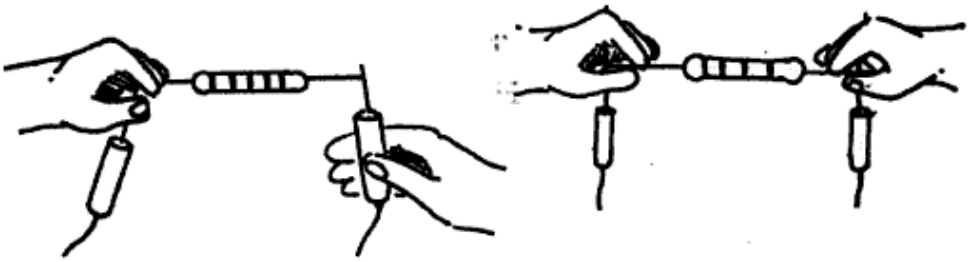
— Color code the Resistor. Color coding will be discussed on page 18.

— Then proceed to the calibration of the ranges. Review ohmmeter calibration from page 2.

— Don't hold both terminals with the test probe. Only one hand must hold a terminal while the other is insulated, as shown in the figure below.

Figure:

Proper **Improper**



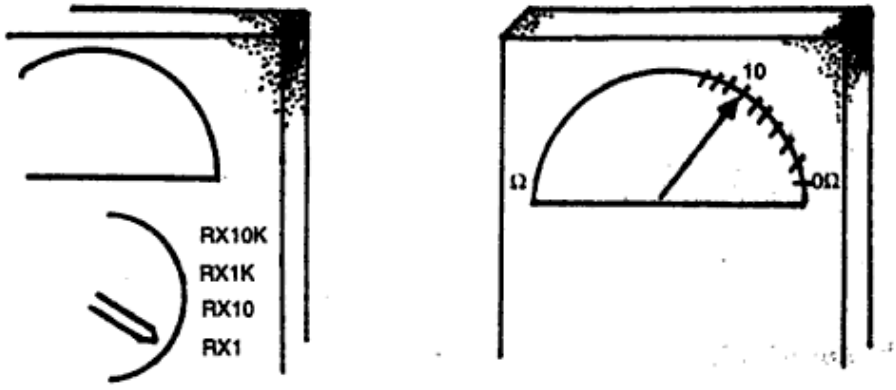
— To get the measured value, multiply the range being used by the indicated value.

Urheberrechtlich geschütztes Material

For example:

Figure:

Range Being Used (R.B.U.) **Indicated Value (I.V.)**



This means: R.B.U. x I.V. = MEASURED VALUE

R x 1 x 10 = 100 ohms

AMOUNT OF RESISTANCE THAT CAN BE MEASURED IN EVERY RANGE

RANGES	MIN.	MAX.
Rx1	.2 Ω	2000 or 2k
Rx10	2 Ω	20000 or 20k
Rx1000 or 1k	200 Ω	2000000 or 2M
Rx10000 or 10k	2000 Ω	20000000 or 20M

∞ — infinite resistance (OPEN CONDITION)

0 OHM — zero resistance (SHORTENED CONDITION)

EXERCISES:

Draw the Ohmmeter scale and pinpoint the following values.

Measured Value	Range Being Used
1. 12 Ω	Rx1
2. 12 Ω	Rx10
3. 26000 Ω	Rx1000

Urheberrechtlich geschütztes Material

4.	60 Ω	Rx1
5.	350 Ω	Rx10
6.	1.4 Ω	Rx1
7.	340000 Ω	Rx10000
8.	900 Ω	Rx10
9.	16000 Ω	Rx1000
10.	2000 Ω	Rx10

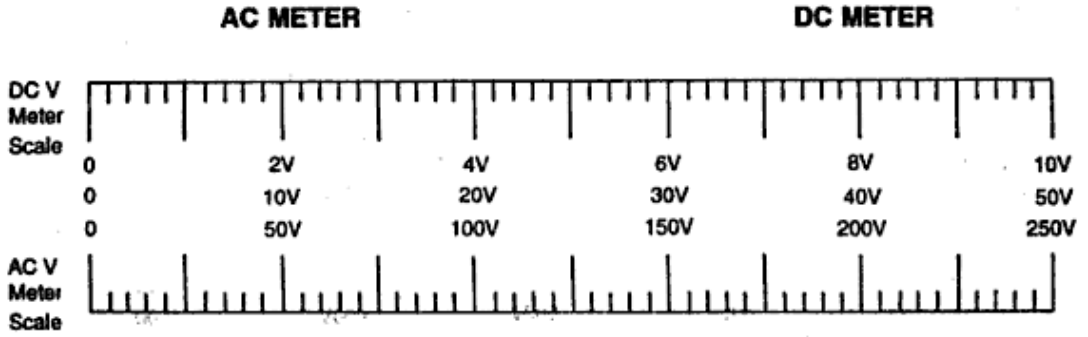
2. VOLTMETER — This circuit is designed to measure AC and DC voltage. The DC meter must observe proper polarity — RED for POSITIVE terminal and BLACK for NEGATIVE terminal. If reverse polarity is applied, the pointer deflects to the left part of the scale. An AC meter does not require proper polarity at all.

In using these meters, one must observe the proper range being used. If an unknown quantity is to be measured, start using the HIGHEST RANGE and gradually adjust it to lower ranges to obtain the right measurement. This is important to avoid damage from the meter.

Make the necessary CALIBRATION of the needle by adjusting the meter needle corrector (see page 2) so that the pointer will rest at zero label (to the LEFT of the scale) before measuring the voltage to obtain accurate reading.

Don't forget to turn on the unit under test and never hold the two metal rods in measuring high AC VOLTAGE to avoid electric shock.

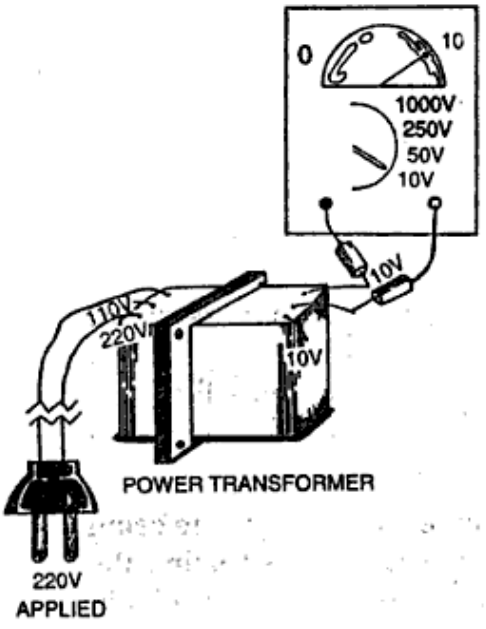
ILLUSTRATION



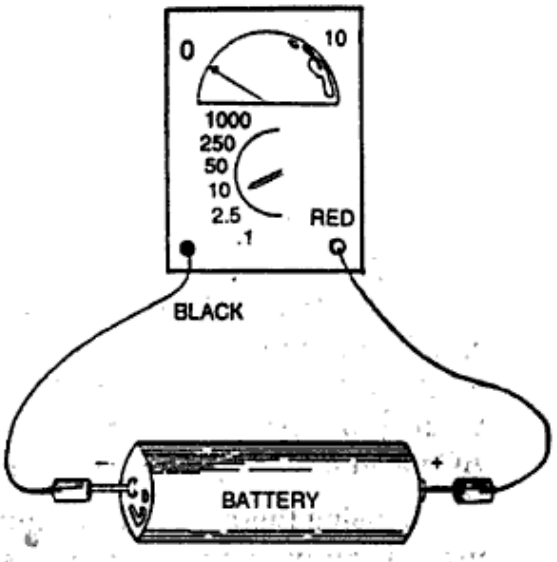
Urheberrechtlich geschütztes Material

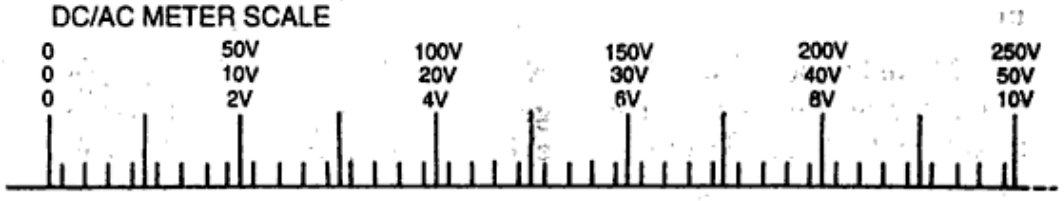
MEASURING VOLTAGES

AC Voltage



DC Voltage



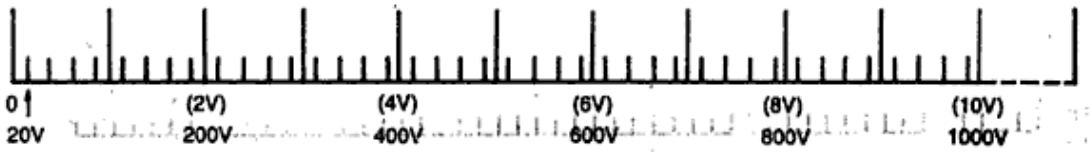


Ranges

AC — 1000 V, 250 V, 50 V, 10 V (Use the RED SCALE.)

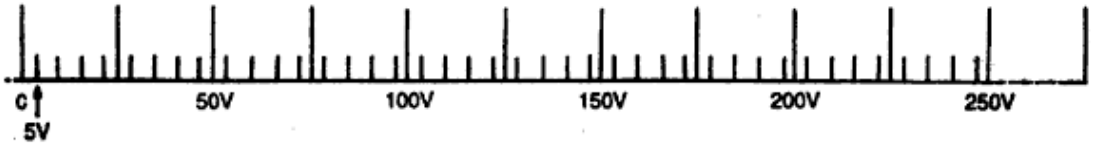
DC — 1000 V, 250 V, 50 V, 10 V, 2.5 V, .5 V, .1 V (Use the BLACK SCALE.)

AC/DC 1000 Assume 10 V as 1000 V

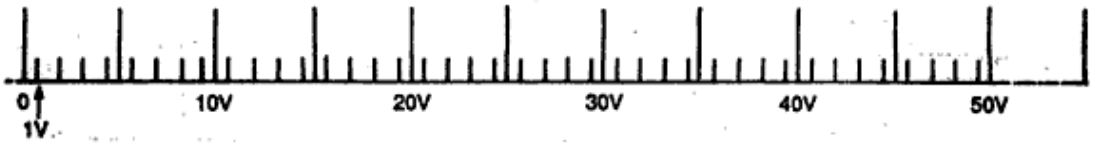


Urheberrechtlich geschütztes Material

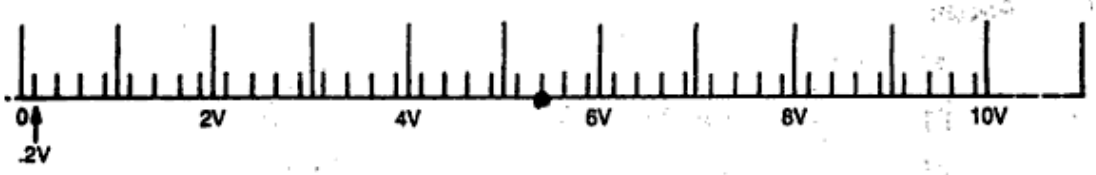
AC/DC 250



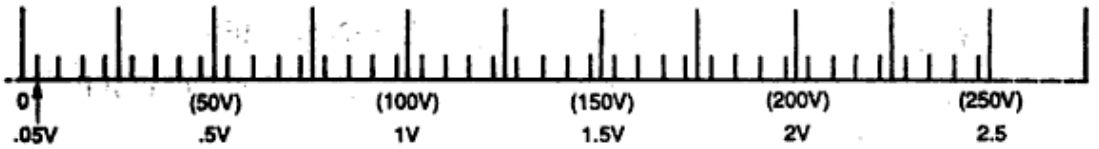
AC/DC 50



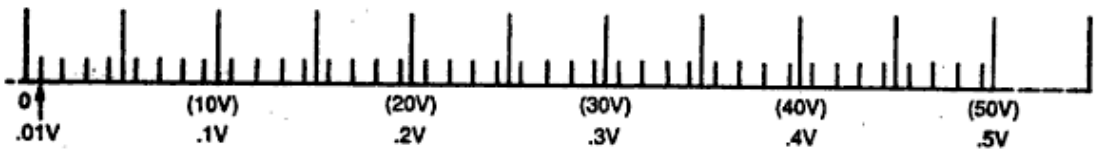
AC/DC 10



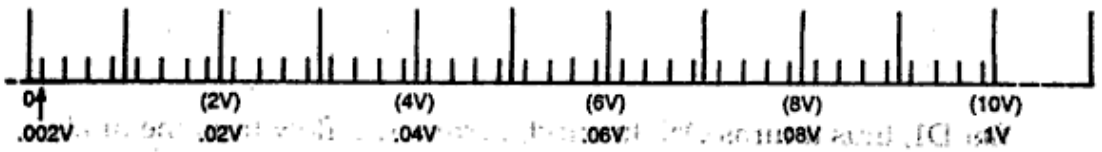
DC 2.5 Assume 250V as 2.5



DC .5 Assume 50V as .5V



DC .1 Assume 10V as .1V



Urheberrechtlich geschütztes Material

EXERCISES:

Draw the AC/DC scale and pinpoint the following values:

AC VOLTAGE	RANGE
1. 220V	1000 V
2. 7.2V	10 V
3. 36V	50 V
4. 3.6V	10 V
5. 180V	250 V

DC VOLTAGE	
1. .7V	2.5 V
2. 11V	50 V
3. 780V	1000 V
4. .064V	.1 V
5. 1.15V	2.5 V

3. MILLIAMMETER — This circuit is designed to measure the amount of DC current flowing in the circuit. To be able to measure this electrical quantity, cut the line and insert the ammeter connecting it in SERIES with the circuit; thus the DC current will flow through the moving coil; observe the proper polarity. ty.

If an unknown quantity is to be measured, start using the HIGHEST RANGE and gradually adjust to the lower range to obtain the right amount and to avoid damage from the meter.

Urheberrechtlich geschütztes Material

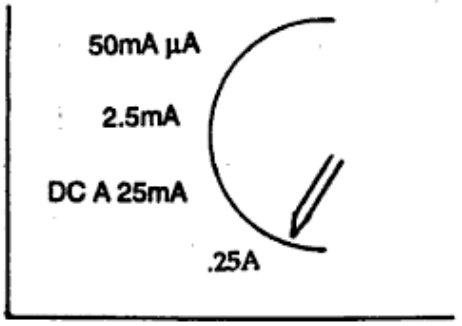
Never use this meter in measuring the DC or AC voltage to avoid damage in the VOM circuitry.

ILLUSTRATION

A — ampere

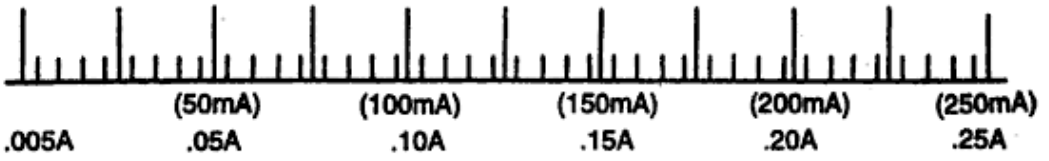
mA — milliampere (thousandth)

μA — microampere (millionth)

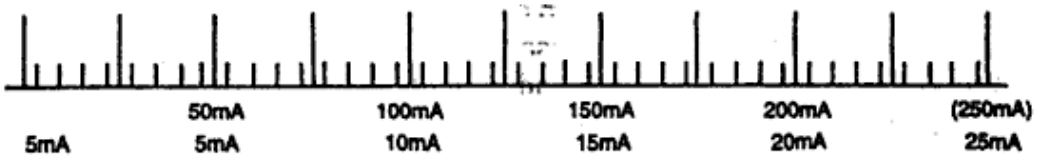


RANGES — 25mA, 2.5mA, 50μA

1. .25A Assume 250mA as .25A

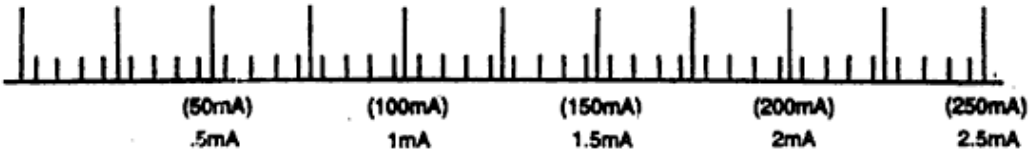


2. 25mA

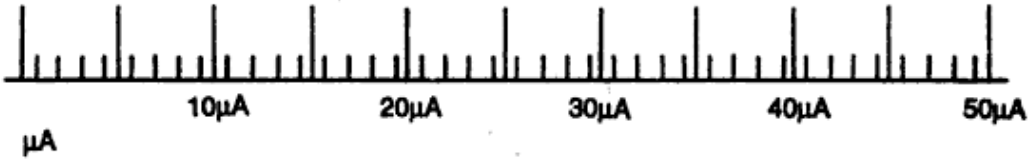


Urheberrechtlich geschütztes Material

3. 2.5mA Assume 250 mA to be 2.5 mA.



4. 50μA



EXERCISES:

Draw the scale of DC milliammeter and pinpoint the following values:

	Measured Value	Range		Measured Value	Range
1.	12.5mA	25mA	6.	1.4mA	2.5mA
2.	23.5mA	25mA	7.	47mA	50mA
3.	9mA	25mA	8.	.6mA	2.5mA
4.	6mA	25mA	9.	22mA	50mA
5.	28mA	50mA	10.	17mA	25mA

TEST MEASUREMENT

At this point, the application of voltage measurement by the aid of VOM must be thoroughly observed. Review the previous lesson regarding the use of voltmeter and ammeter.

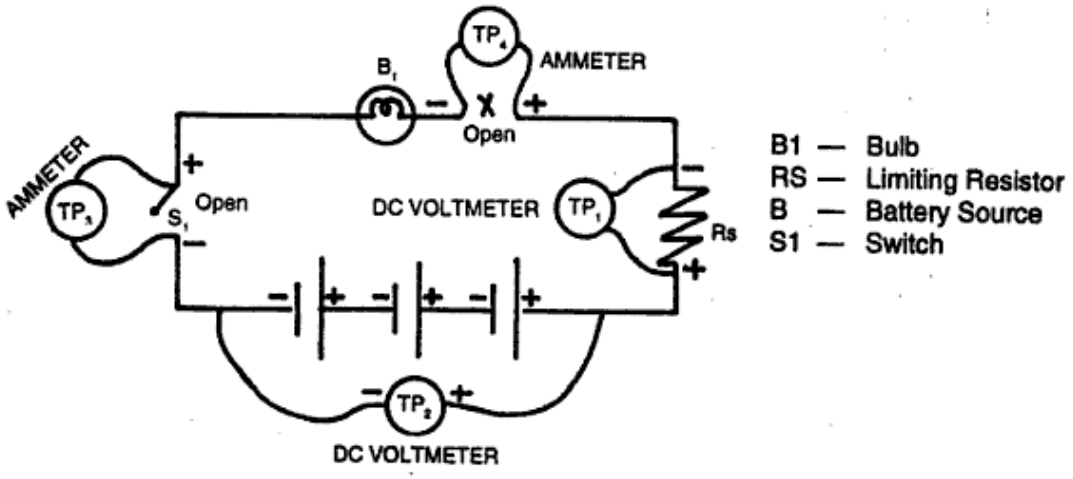
Note: Do this Laboratory activity with the supervision of an ELECTRONICS TRAINER.

Urheberrechtlich geschütztes Material

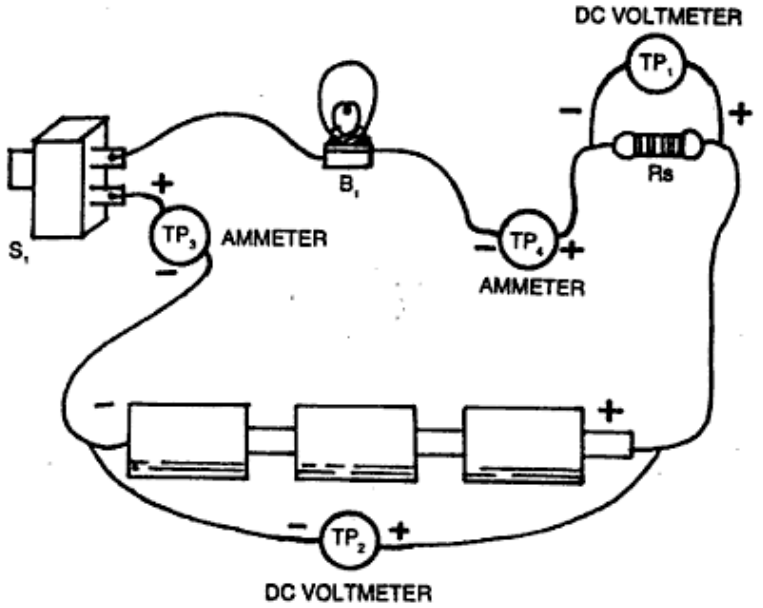
Materials:

Battery	3 pcs.
Resistor 470 ohms 1/4 watts	1 pc.
6V bulb	1 pc.
Slide switch	1 pc.
Alligator Clips	8 pcs.

Circuit diagram



Wiring installation



Urheberrechtlich geschütztes Material

Procedures:

1. Check the following components by using the ohmmeter
   a. Resistor
   b. Alligator clips
   c. Switch
   d. Bulb
2. Measure the Battery by the DC Voltmeter
3. Construct the given circuit.
4. TURN ON the circuit. The bulb will light; if not, check for a discharged battery or disconnection of wire.
5. Measure the following test points:
   a. TP 1
   b. TP 2
   c. TP 3
   d. TP 4

Observe proper polarity.

TABLE

	VOLTAGE	RANGE
TP 1		
TP 2		

	CURRENT	RANGE
TP 3		
TP 4		

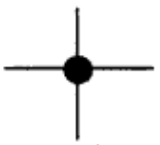
Urheberrechtlich geschütztes Material

BASIC ELECTRONICS

Diagramming

This lesson covers the understanding of circuit analysis on how to interpret interconnection lines to be able to trace down the defective component as well as understanding the GUIDE to TROUBLESHOOTING TECHNIQUES.

SETS OF CROSS LINES PATTERN

	SET A	SET B	SET C
NOT CONNECTED			
CONNECTED			

NOT CONNECTED — This means that the horizontal line is not connected to the vertical line.

CONNECTED — This means that the vertical line and the horizontal line are connected to each other. See the figure below.

Urheberrechtlich geschütztes Material

Horizontal Line

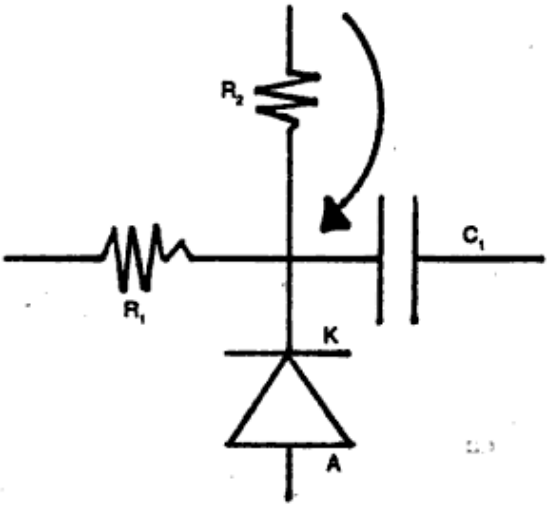
Vertical Line

Legend:

For example:

a. NOT CONNECTED

Figure 1



Legend

any component

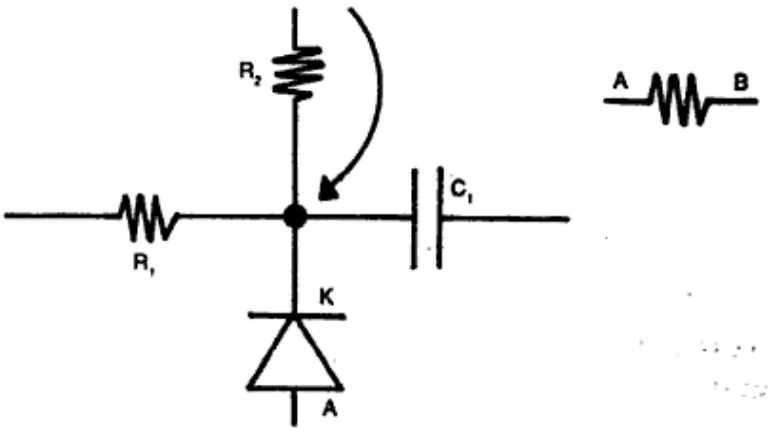
A — Anode
K — Cathode
C1 — Capacitor 1
R1 — Resistor 1
R2 — Resistor 2

Thus, terminal B of R1 is connected to terminal A of C1 and not connected to cathode terminal of D1 and terminal B of R2 Connection.

Urheberrechtlich geschütztes Material

b. CONNECTED

Figure 2



Lines A and B are all connected.

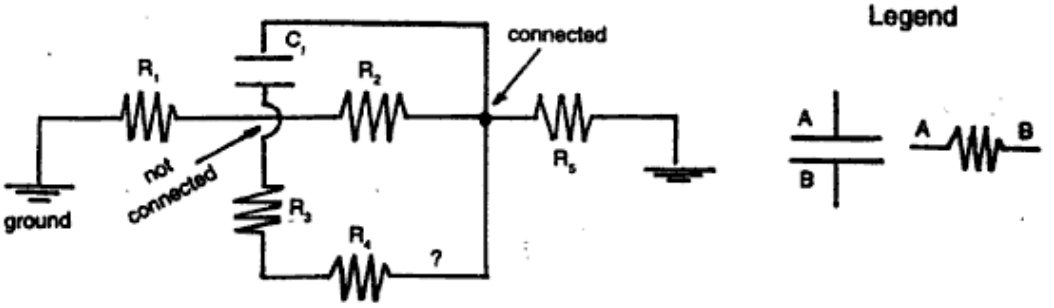
Note: Only pairs of connections are USED; that's why in circuit analysis these must be observed.

EXERCISES:

Look for the connected terminals of the components.

For example:

Figure 1



1. What are the terminals connected at TERMINAL B of R4?

   Ans. — terminal A of R5

   — terminal B of R2

   — terminal A of C1

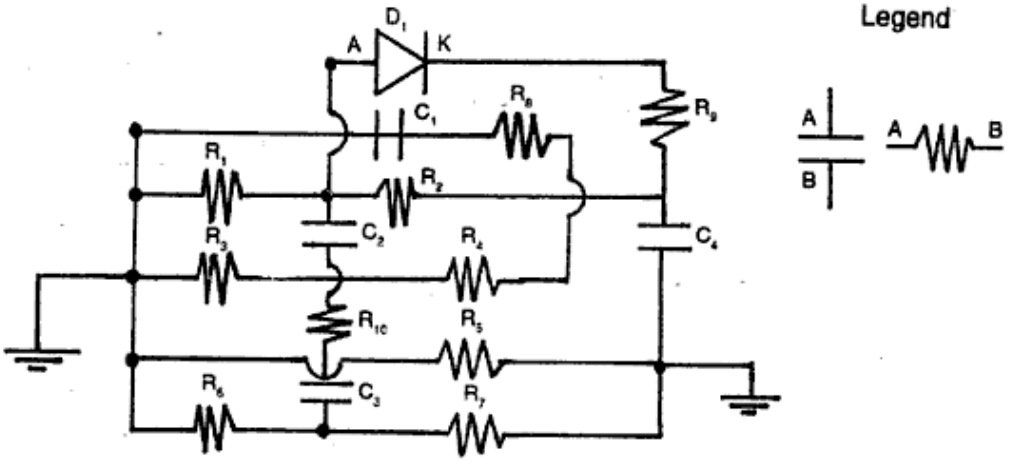
Urheberrechtlich geschütztes Material

2. What terminal is connected at TERMINAL A of R2?

Ans. — terminal B of R1 only.

EXERCISES:

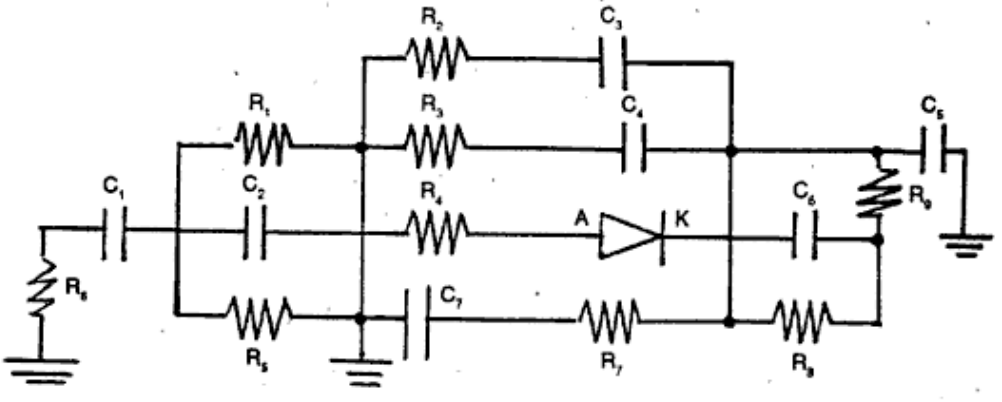
1. Figure A.



Note: The ground symbols indicate they are all connected. The use of ground symbols are applied to minimize such lines but they are understood as CONNECTED.

1. What terminals are connected at
   a. terminal B of C4?
   b. terminal A of D1?

2. Figure B.



Urheberrechtlich geschütztes Material

1. What are the terminals connected at
   a. terminal A of C5?
   b. terminal B of R6?
   c. terminal A of R5?

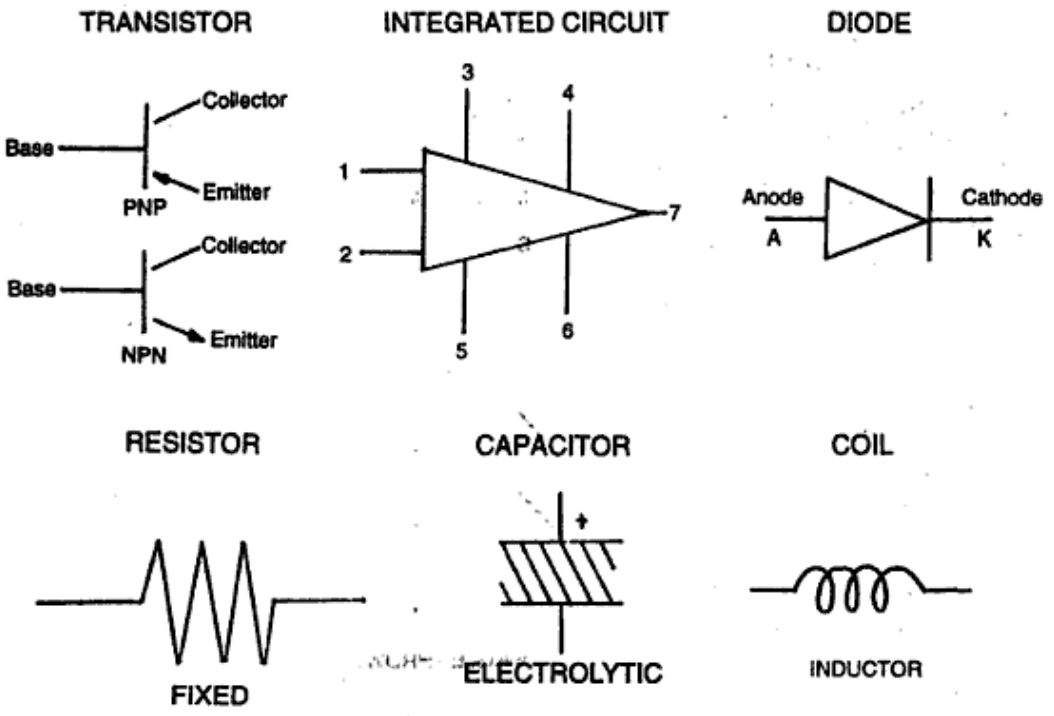
Note: The answers of the exercises are on the last page of this module.

ELECTRONIC COMPONENTS AND SYMBOLS

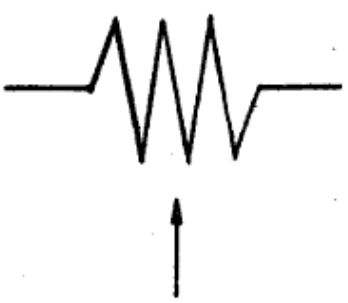
Active components are defined as the Heart of the Unit, where they perform an important task with regard to the operation of the circuit. Some of these are the TRANSISTOR, INTEGRATED CIRCUIT, DIODE, THYRISTORS.

Passive components are defined as the supporting components for the active parts to operate normally. These are the RESISTOR, CAPACITOR, and COIL.

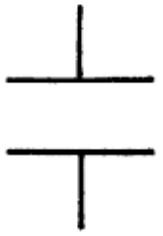
ELECTRONICS SYMBOLS



Urheberrechtlich geschütztes Material



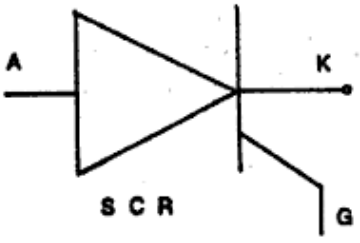
VARIABLE RESISTOR



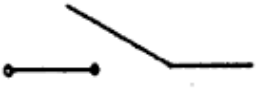
FIXED (non-polar) CAPACITOR

SWITCHES

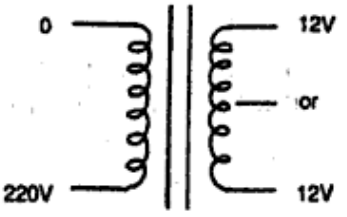
TRANSFORMER



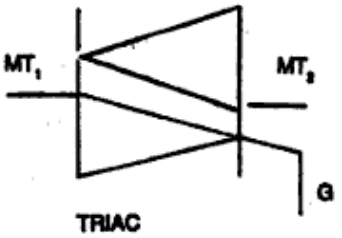
S C R



SINGLE POLE SINGLE THROW

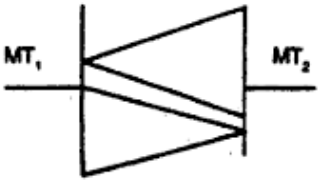


CENTER TAPPED

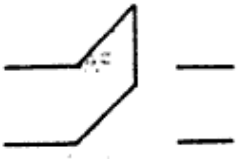


TRIAC

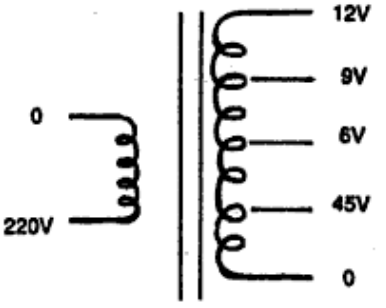
SINGLE POLE DOUBLE THROW



DIAC



DOUBLE POLE SINGLE THROW



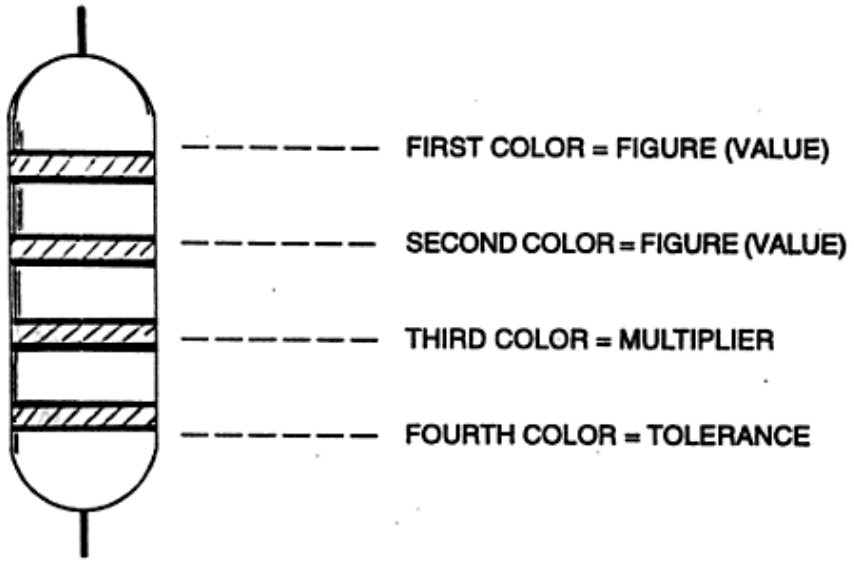
MULTI-TAPPED

Urheberrechtlich geschütztes Material

RESISTOR COLOR-CODING

Resistance is an opposition to the CURRENT in the circuit. Carbon types are Color-Coded Values. This lesson gives an understanding of COLOR CODING. The Unit used for resistance is the OHM symbol Ω .

FIGURE:



COLOR CODE TABLE

COLORS	FIRST & SECOND COLOR (VALUE)	THIRD COLOR (MULTIPLIER)	FOURTH COLOR (TOLERANCE)
Black	0	x 1	
Brown	1	x 10	
Red	2	x 100	
Orange	3	x 1000	
Yellow	4	x 10000	
Green	5	x 100000	
Blue	6	x 1000000	
Violet	7	x 10000000	
Gray	8	x 100000000	
White	9	x 1000000000	
Gold		x .1	5%
Silver		x .01	10%

Urheberrechtlich geschütztes Material

For example:

1. RED RED BROWN GOLD

   2 2 X 10 5%

   Ans. 22 X 10 = 220 OHMS 5%

2. ORANGE BROWN RED SILVER

   3 1 X 100 10%

   Ans. 31 X 100 = 3100 OHMS 10%

3. YELLOW BLACK ORANGE GOLD

   4 0 X 1000 5%

   Ans. 40 X 1000 = 40000 OHMS 5%

SEATWORK:

A. Give the Color-Code Value
   1. Orange Blue Yellow Gold =
   2. Green Orange Brown Silver =
   3. Violet Green Black Gold =
   4. White Red Gold Silver =
   5. Gray Orange Brown Gold =

B. Convert the following values to color codes.
   1. 1,200 ohms 5% =
   2. 500 ohms 10% =
   3. 470000 ohms 10% =
   4. 10 ohms 5% =
   5. 39 ohms 10% =

Urheberrechtlich geschütztes Material

ACTUAL RESISTANCE MEASUREMENT

In this lesson, actual reading of CARBON RESISTORS and checking with the use of VOM are applied. Review the previous lesson regarding the Ohmmeter. See page 2. This is advisable to complete the test properly.

Materials:

— assorted values of Resistors - 20 pcs.

— VOM

This activity must be done individually and under the supervision of an instructor.

TABLE

Resistor	Color-Code Value	Measured Value	Range
R1			
R2			
R3			
R4			
R5			
R6			
R7			
R8			
R9			
R10			
R11			
R12			
R13			
R14			
R15			
R16			
R17			
R18			
R19			
R20			

TROUBLES IN RESISTORS

OPEN — Even using all ranges, there's no deflection from the OHMMETER.

Urheberrechtlich geschütztes Material

CHANGE VALUE — Resistance tends to increase and not to decrease; thus, increase of resistance based on the actual value is considered defective.

For example:

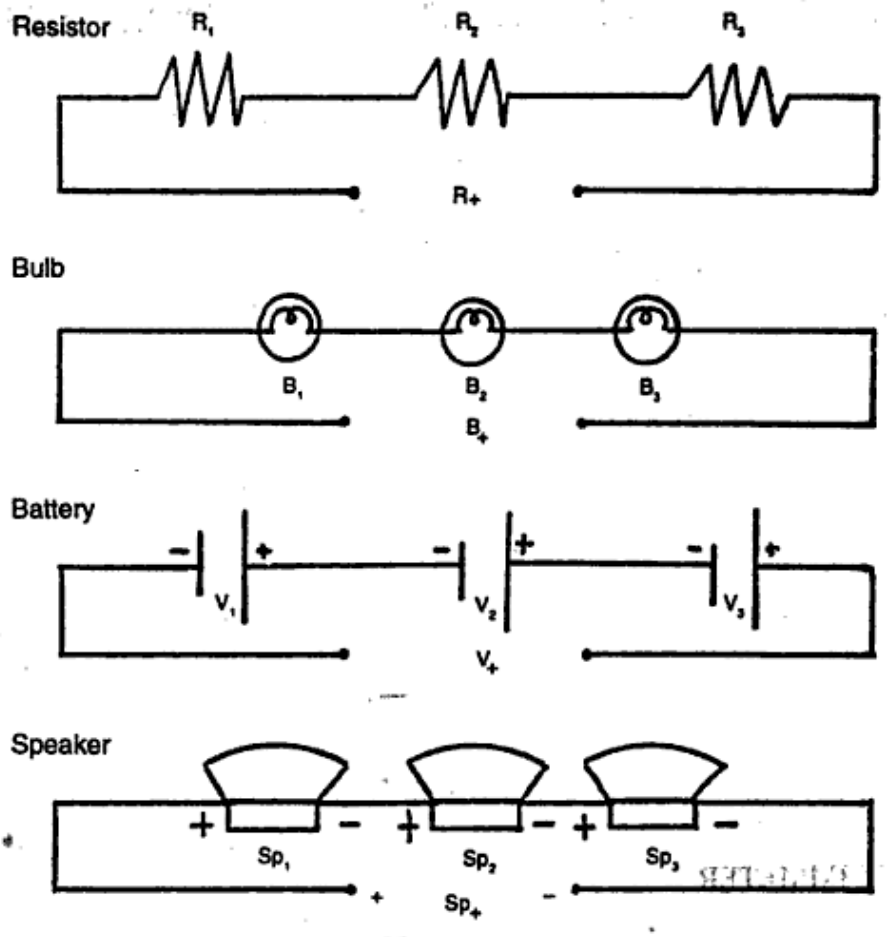
color-code value	measured value
470 ohms	10,000 ohms

The result indicates that the resistor is found defective because its resistance has increased.

SERIES AND PARALLEL CONNECTION

A. Series — The resistors are connected in line with each other. The result of total resistance is additive; thus the resistance and voltage increases.

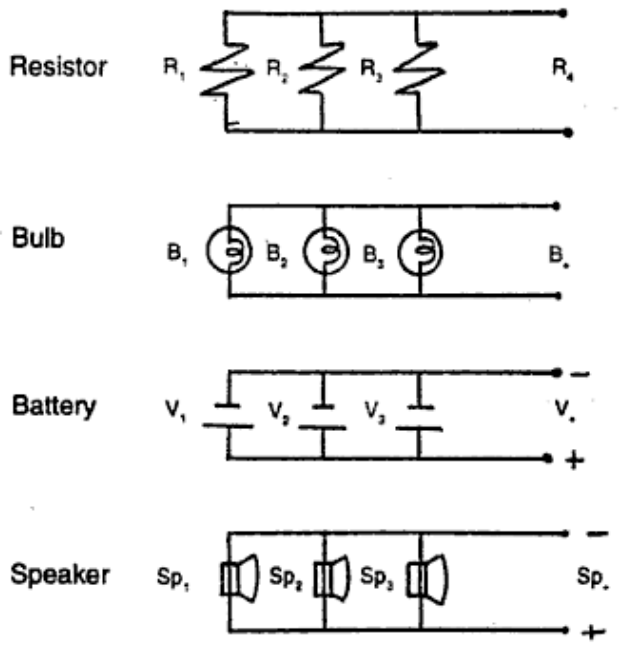
Figure 1



Urheberrechtlich geschütztes Material

B. Parallel — The components are arranged and connected ACROSS each other as shown in the figure.

Figure 1



OHMMETER CHECKING

A. Carbon Resistor — The Color-Code value must be the same with the resultant measured value.

Procedure in Measuring Resistor Values Properly

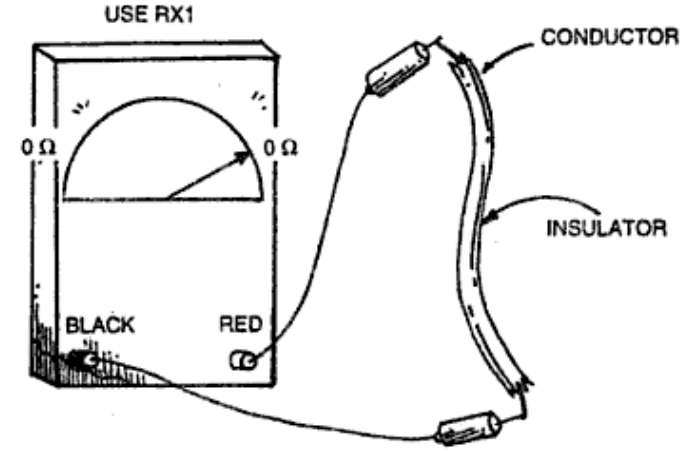
1. Color-Code the Resistor. See page 18.
2. Select the proper range.
3. Calibrate the Range being used. See page 2 for calibration procedure.
4. Proceed to measurement.
5. Never hold both terminals with bare hands when measuring to obtain accurate reading.

Urheberrechtlich geschütztes Material

CONTINUITY CHECKING

Wires are hard to visualize if an OPEN LINE occurs. Check the resistance on both ends of the wire by means of Continuity checking with the aid of the Ohmmeter as shown in the figure.

Figure:

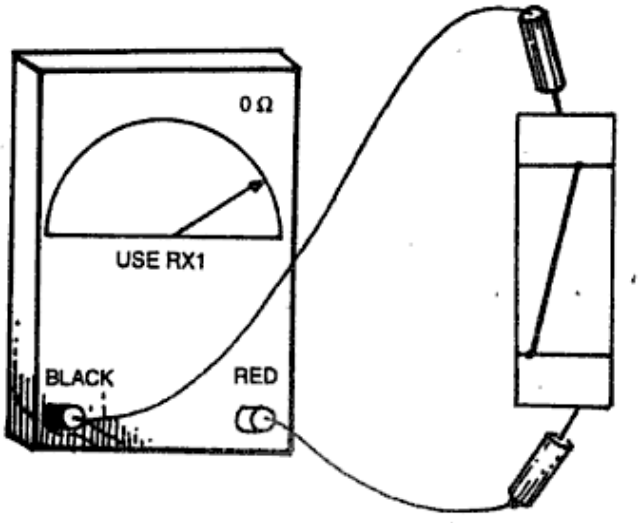


CONDITION OF THE WIRE

A. Good — A ZERO resistance must be obtained at both terminals of the wire. The pointer will FULLY DEFLECT.

B. Defective — An INFINITE resistance must be obtained at both terminals of the wire. This means that the pointer will not DEFLECT.

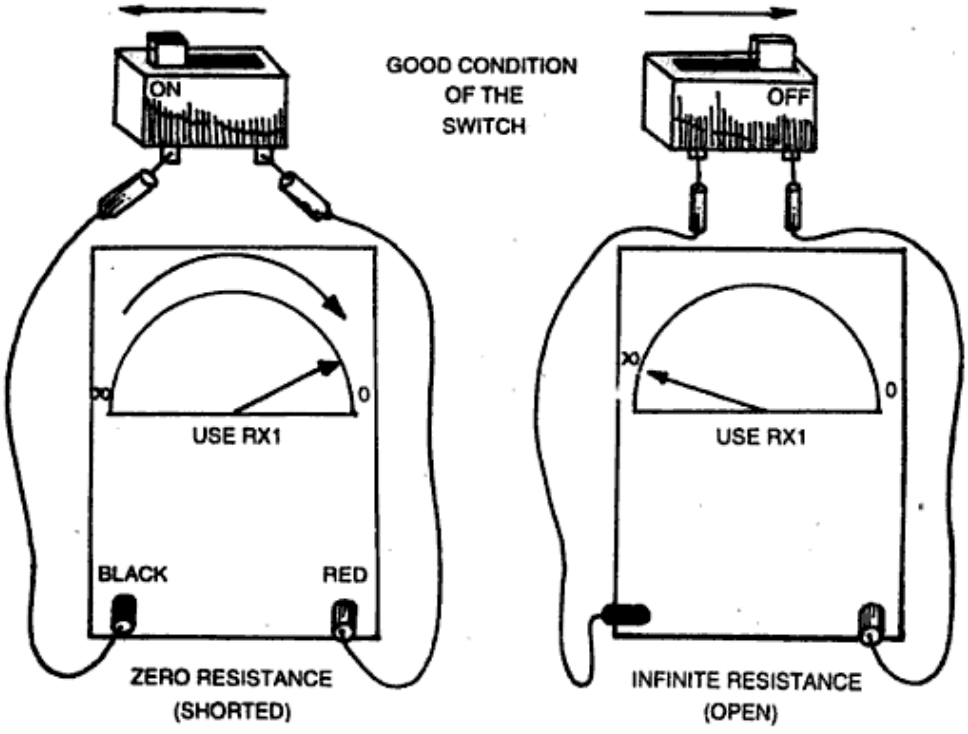
Checking of FUSE



Note: Same condition of the wire.

Urheberrechtlich geschütztes Material

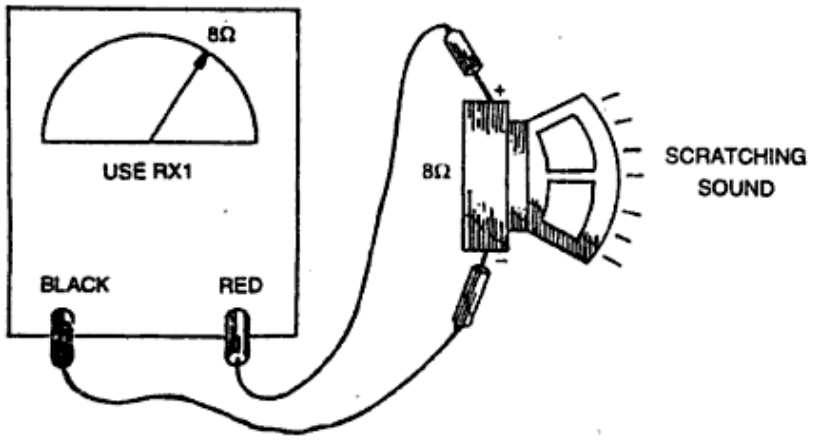
Checking of the SWITCH



SPEAKER CHECKING

A specified IMPEDANCE is marked in every speaker such as 4 ohms, 8 ohms, 16 ohms respectively and this rating must be obtained in doing resistance measurement thru the OHMMETER as shown in the figure.

Figure

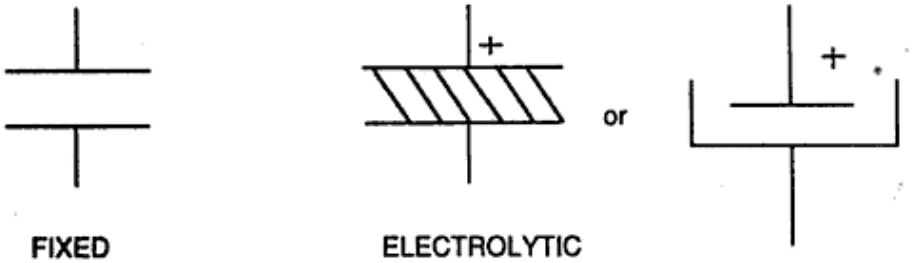


Urheberrechtlich geschütztes Material

CAPACITOR

Charging and discharging can show that the capacitor is in GOOD CONDITION. Practice in checking the Capacitor will give more exposure with regard to the condition of the Capacitor.

FARAD is the unit used for capacitance with the symbol f. Values of small quantities of picofarad, and microfarad. Some capacitors have polarity and are called ELECTROLYTIC capacitors while the capacitors with no polarity are called NON-POLARIZED capacitors. Symbols for capacitors are shown in the following figures.



FIXED ELECTROLYTIC

CHECKING OF CAPACITORS

Electrolytic — Use Rx1, Rx10, and Rx1000 or 1k because these are the capacitors that have the highest range. Each capacitor has a rating of working voltage and the applied voltage must not overcome the rating of the capacitor. Improper connection of this type will damage the capacitor and sometimes explode if high voltage is applied to it. Observe precautionary measures when dealing with polarized capacitors. In replacing the value, don't use the lower rating of working voltage. Replace the same rating for proper operation. Example of values: 10µf/10V, 4.7µf/16V, 1µf/25V

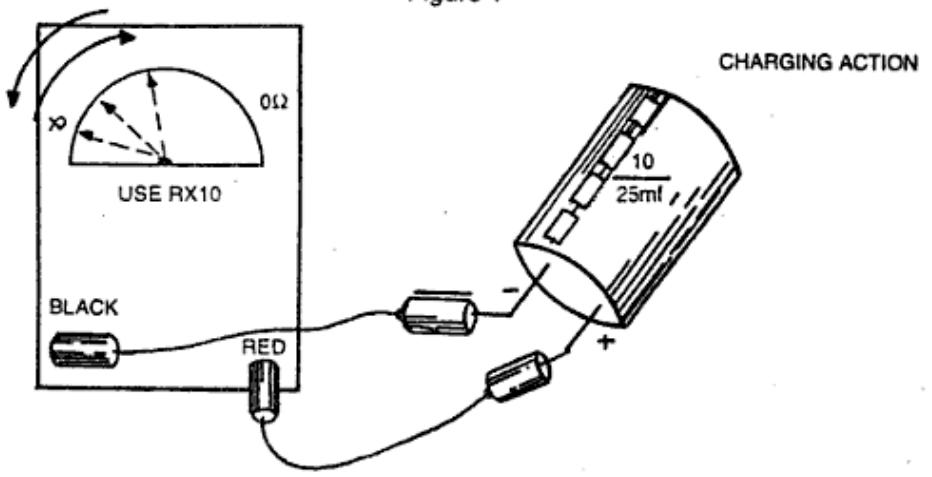
VALUES	RANGE
1µf - 10µf	R x 10 or R x 1k
16µf - Hundreds and thousands of farad	R x 1 or R x 10

microfarad = µf

Urheberrechtlich geschütztes Material

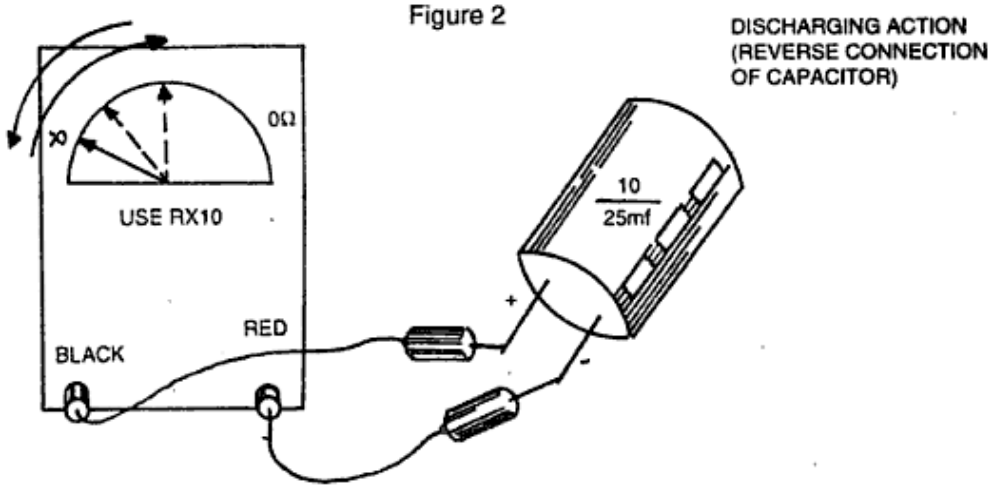
Use ranges that can show slight deflection of the pointer.

Figure 1



A. CHARGING — The moment test probes are connected to the terminal of the capacitor, the pointer will DEFLECT and will gradually deflect back to infinite resistance. Never remove the connection of the test probes and wait until the pointer reaches the original position or infinite resistance. Repeating this checking will not show any deflection of the pointer. This means the capacitor is fully charged as shown in the figure

Figure 2



B. DISCHARGING — This will be the reverse checking of the capacitor. This time the same deflection will happen just like charging as shown in the figure.

Urheberrechtlich geschütztes Material

C. NON-POLAR — These are the capacitors that have no polarity and have the lowest amount of capacitance. In checking this type, always use the highest range of your VOM. Some of this type shows a quick deflection of the pointer.

Values of Non-polar

A. MYLAR type

Appearance

Note:

pf — picofarad
mf — microfarad
3rd number — multiplier
1st & 2nd numbers — values

For example: 223

1st	2nd	3rd		
2	2	(X1000)	=	22000pf. In converting to µf, move the decimal point to the left SIX TIMES; thus the actual value must be .022 µf.
values		multiplier		

SEATWORK:

1. 104 = 1 0 X 10000
   = 100000
   ans. = .1 µf

2. 224 = 2 2 X 10000
   = 220000
   ans. = .22 µf

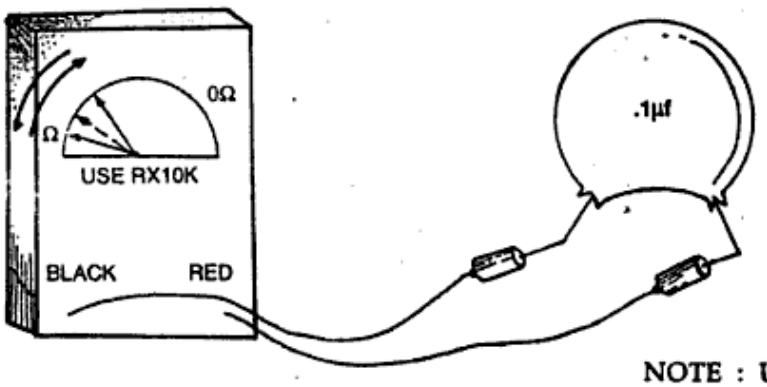
Urheberrechtlich geschütztes Material

B. CERAMIC TYPE — The values are in microfarad; thus, there is no need for conversion, as shown in the figure.

Appearance

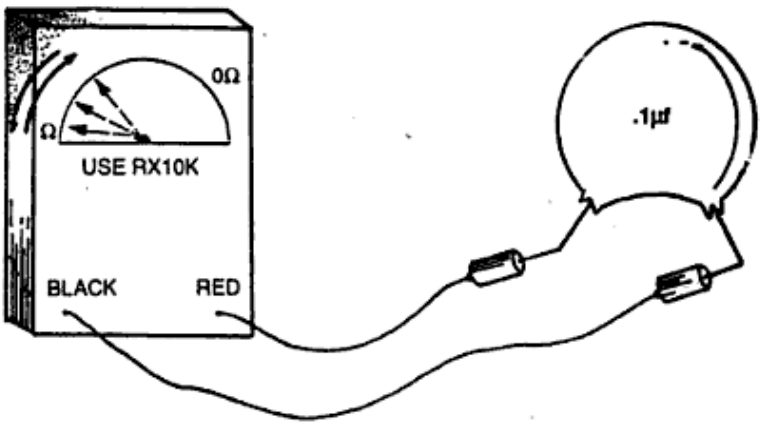
CHECKING OF NON-POLAR CAPACITOR

A. CHARGING



NOTE : Usual DEFLECTION for NON-POLAR is slight only.

B. DISCHARGING

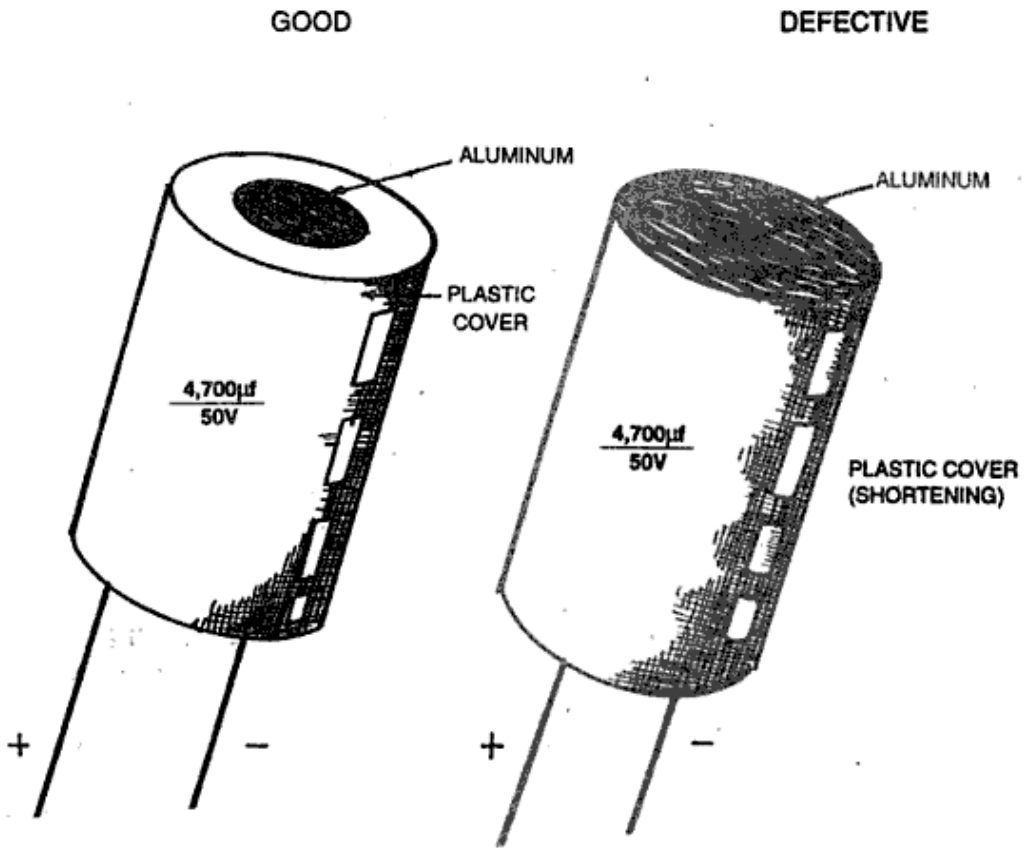


Urheberrechtlich geschütztes Material

TROUBLES IN CAPACITOR

Electrolytic types sometimes can visualize a defective component by looking at the plastic cover that shows some sort of SHORTENING; thus, the aluminum foil will appear. Check this at the bottom and top view of the capacitor as shown in the figure.

Figure:



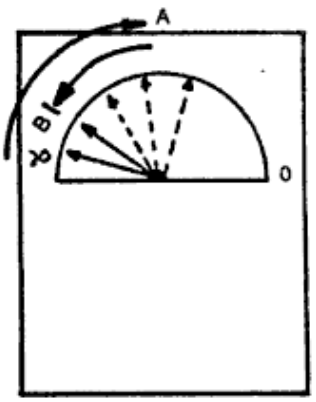
OPEN — This condition will not cause any DEFLECTION of the pointer at all. This means there will be no more charging and discharging of the capacitor.

SHORTED — This condition shows full deflection of the pointer, even using all ranges for both checking (charging and discharging actions).

Urheberrechtlich geschütztes Material

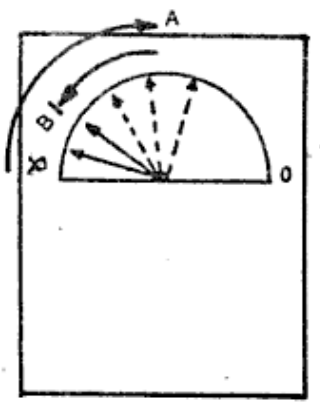
LEAKY — This condition shows high resistance but not infinite resistance to both checking when the pointer deflects back to infinite resistance, as shown in the figure.

Figure:



A — Deflects to Low Resistance

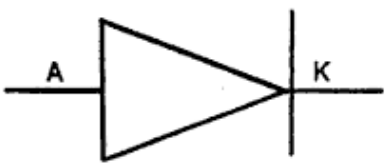
B — Gradually Deflects Back to High Resistance and Not Infinite



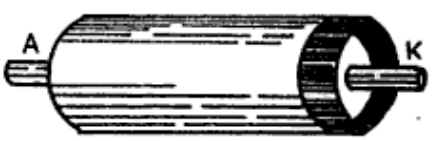
See p. 26.
The Deflection of Good Capacitor

C. **DIODE** — This is a semiconductor known as the PN JUNCTION. It has two terminals, the ANODE and the CATHODE. The values of the diode start with 1N such as 1N4001, 1N5401, etc.

symbol



appearance

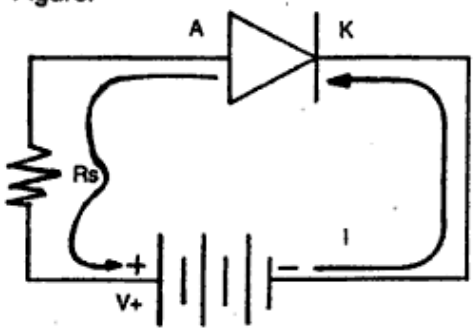


This component needs operating DC voltage in order to operate. It is called FORWARD BIAS and the other operating DC voltage is called REVERSE BIAS, from which it causes the diode to TURN OFF or it will not operate. The BIASING is shown in the figure.

A. **FORWARD BIAS** — Positive voltage is applied at the ANODE while negative voltage is applied at the CATHODE terminal of the diode. It allows current to flow , thus causing the bulb to light.

Urheberrechtlich geschütztes Material

Figure:

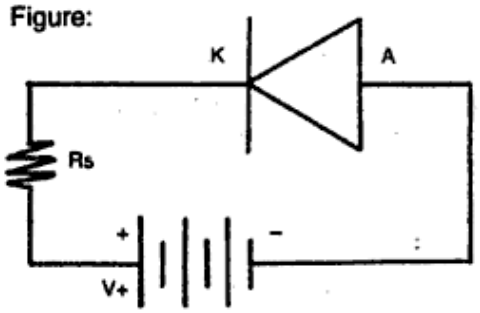


Rs — Limiting resistor

Current Will Flow

B. REVERSE BIAS — At this point, reversing the diode is necessary and will cause the OFF condition of diode as shown in the figure.

Figure:



No Current Flow

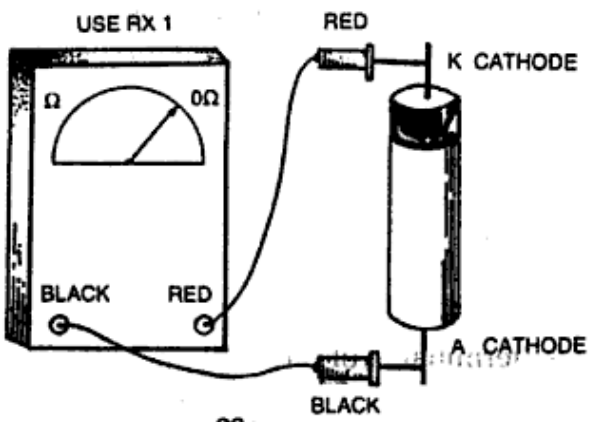
Note: Measuring the bias voltage at the Anode and Cathode must be around .6 volt for a normal operation in forward Bias.

CHECKING OF THE DIODE

A. FORWARD CHECKING

A low resistance must be obtained. Use R x 1 range.

Figure:

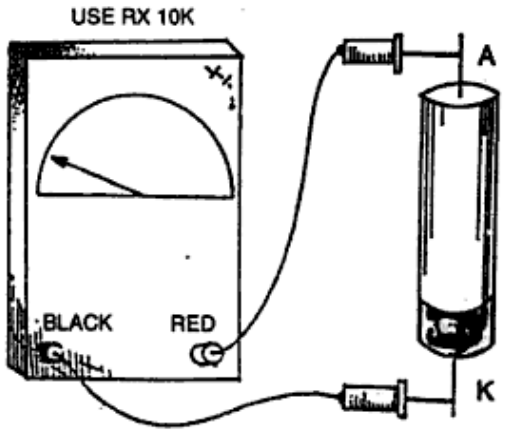


Urheberrechtlich geschütztes Material

B. REVERSE CHECKING

At this point an INFINITE RESISTANCE must be obtained.

Figure:

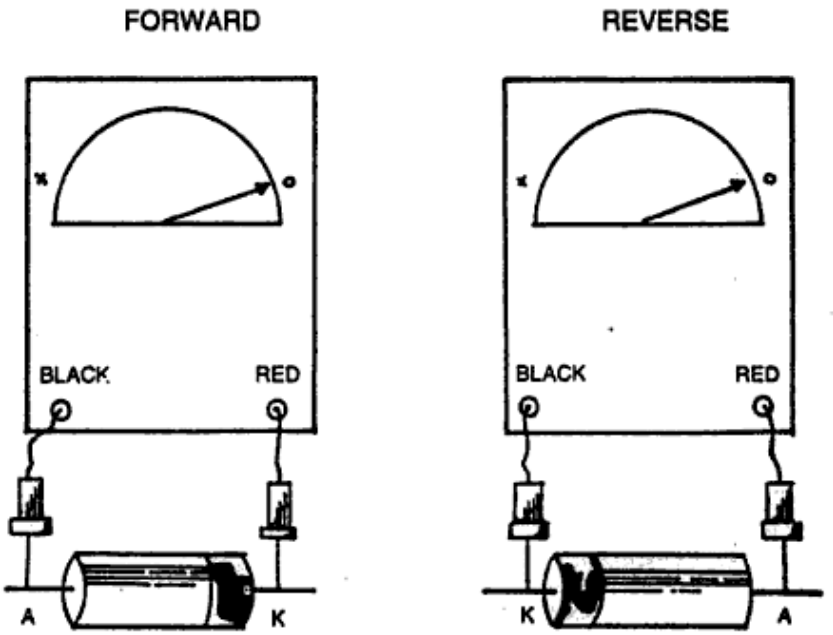


The VALUES of DIODE commonly starts with 1N; for example, 1N4001, 1N5401. 1N means PN junction or ONE junction.

DEFECTIVE CONDITION

1. SHORTED — The resistance on both checking is ZERO RESISTANCE.

Figure:

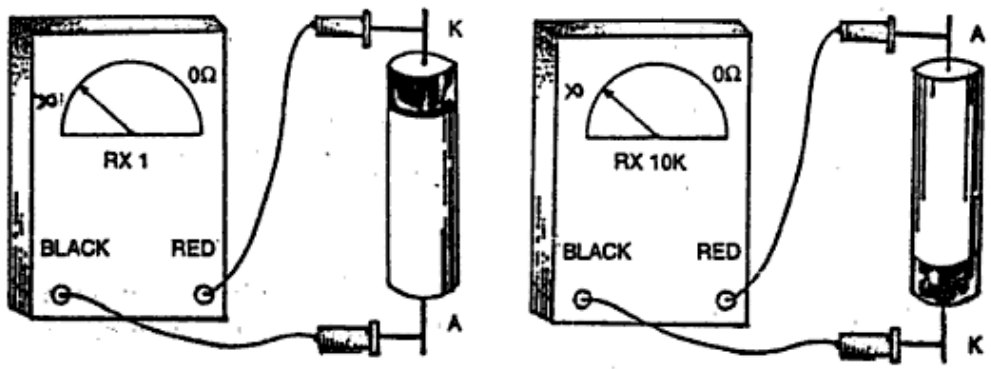


Urheberrechtlich geschütztes Material

2. OPEN — The resistance on BOTH CHECKING is INFINITE RESISTANCE. This means no deflection from the METER.

Figure:

FORWARD

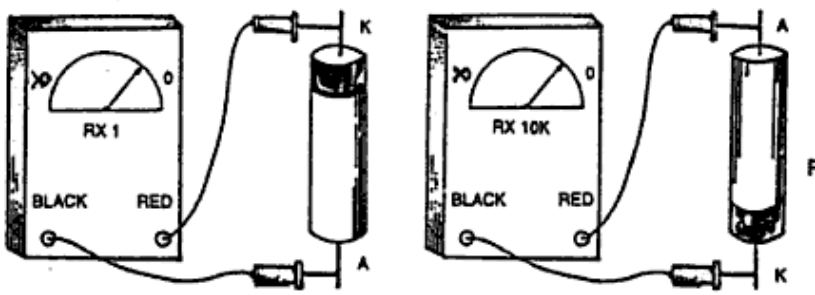


3. LEAKY — At this point, the REVERSE CHECKING shows HIGH RESISTANCE instead of INFINITE RESISTANCE.

Figure:

FORWARD REVERSE

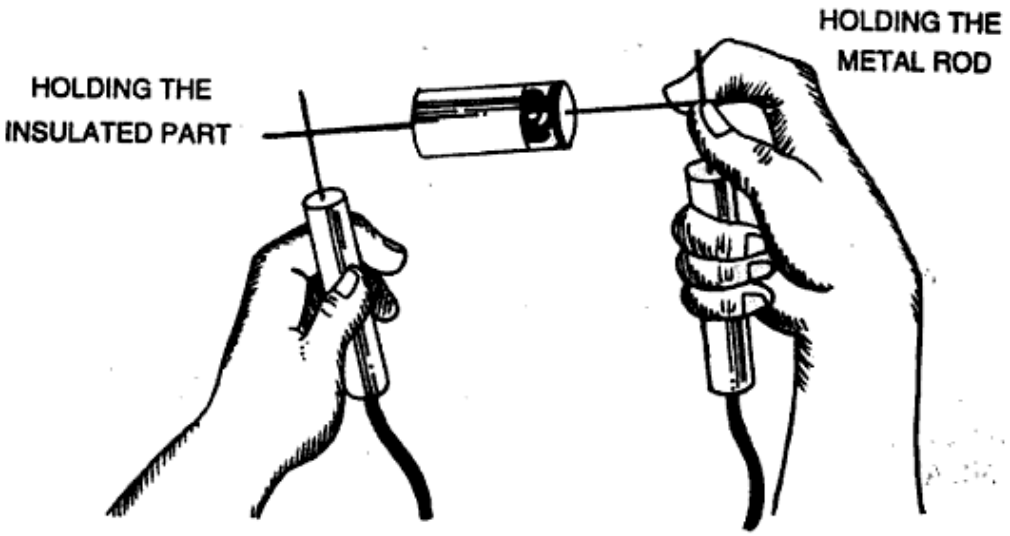
HIGH OR LOW RESISTANCE



LOW OR HIGH RESISTANCE

Do not hold both terminals in testing of the diode, especially the REVERSE CHECKING. This could lead to an error in reading. The proper way is shown in the figure.

Figure:

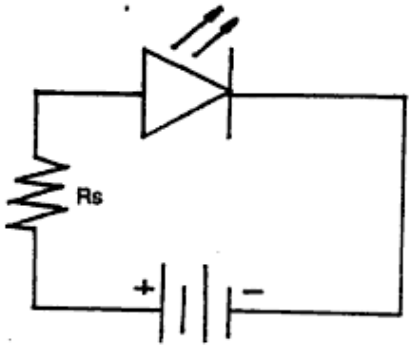


* L.E.D. — Light Emitting Diode

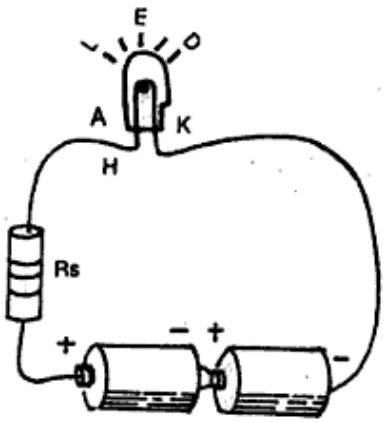
— It is a special type of diode that emits lights the moment FORWARD BIAS is applied as shown in Figure A.

— Its checking is the same with that of an ordinary DIODE. The appearance is shown in Figure B.

Figure A.



CIRCUIT DIAGRAM



WIRING INSTALLATION

DEFECTIVE CONDITION

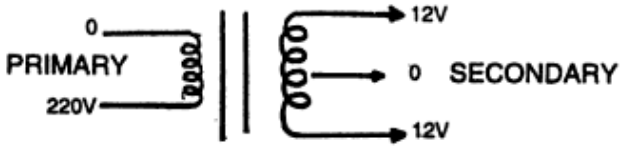
A. OPEN CONDITION — An open winding in the primary of a transformer may result in zero AC voltage at the secondary.

B. SHORTED CONDITION — A burnt-out magnet wire that causes an interconnection with other wires may result in overheating of the transformer and no secondary voltage at all. It will cause the fuse to blow up easily because too much current flows in the transformer.

TRANSFORMER CLASSIFICATION

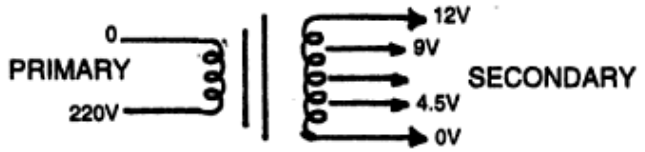
a) SPLIT TYPE OR CENTER TAPPED

Figure:



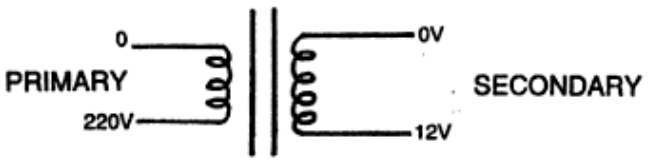
b) MULTI-TAPPED

Figure:



c) DUAL LINE

Figure:

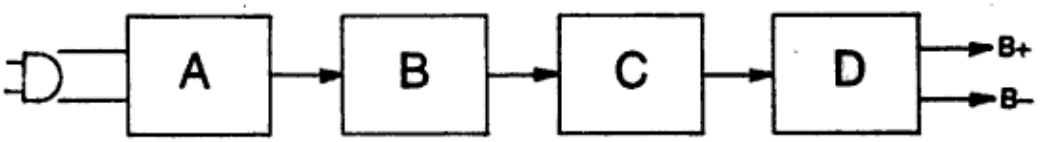


Urheberrechtlich geschütztes Material

AC-DC CONVERTER POWER SUPPLY

Almost all electronic units operated on DC voltage and this source have only limited power on battery. An AC-DC converter plays an important role as an alternative to a battery where the AC source is converted to DC voltage by the aid of a semiconductor and designed circuit. The operation of CONVERTER will be discussed in this lesson.

BLOCK DIAGRAM OF UNREGULATED POWER SUPPLY



POWER TRANSFORMER RECTIFIER FILTER LOAD RESISTOR

THE FUNCTION OF ITS PARTS

A. POWER TRANSFORMER — It is designed to reduce the amount of AC voltage to the desired secondary AC voltage.

B. RECTIFIER — It is a semiconductor that changes AC to DC voltage. It is known as DIODE.

C. FILTER — It is an electrolytic capacitor that is used to eliminate the AC current from the rectified DC current to produce DC voltage. This will be able to remove the humming sound brought about by the presence of AC current.

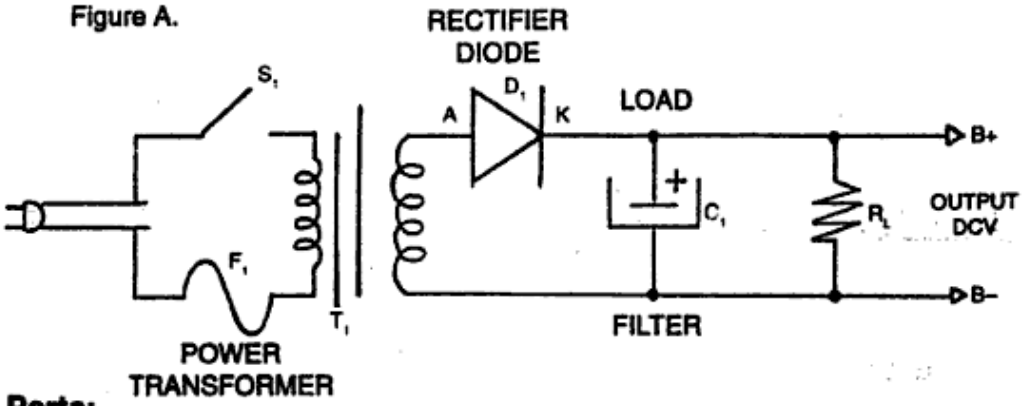
D. LOAD RESISTOR — It acts as the discharging path of the filter capacitor when the unit is turned off.

Urheberrechtlich geschütztes Material

THEORY

The basic schematic diagram of Unregulated Power Supply is shown in Figure A.

Figure A.



Parts:

AC LINE CORD

F1	—	Fuse 250V 2A
S1	—	SWITCH Single Pole Single Throw
T1	—	Power Transformer 6 Ampere 12-0 for CHARGER 1 Ampere 12-0 for low power unit
C1	—	CAPACITOR 4700µf/16V or 2200µf/16V
R1	—	RESISTOR LOAD 1000 ohms 1 watt for CHARGER 1/2 watt for low power
Rs	—	Limiting Resistor 680 ohms 1/4 watt
L.E.D.	—	Light Emitting Diode (big or jumbo), any color

Once the circuit turns on, Alternating Current then flows from one terminal of the plug to F1 moving towards the primary to S1, to the other terminal of the plug; thus large amount of MAGNETIC FIELD develops at the primary winding. INDUCTION takes place. The magnetic field will be developed by means of INDUCTION at the secondary winding and the AC voltage can be measured at the secondary of the transformer.

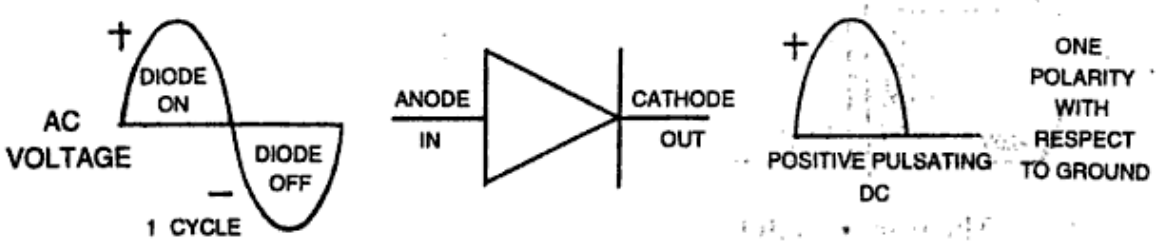
The positive charge of AC voltage will forward the biased rectifier D1; thus it turns ON. In effect, current will flow from the diode

Urheberrechtlich geschütztes Material

to the secondary winding, charging the filter capacitor to the load resistor and again to the diode.

The positive charge is completed and this time the negative charge is applied at the diode. Reversed bias is applied thus causing the diode to turn off and the stored charge from the capacitor will be released. Thus, there will be a continuous flow of current at the load resistor and the voltage is still developed there. The supply of current for the load is maintained. Before having a discharge capacitor, the positive charge of AC voltage is applied at the diode; thus, it turns on and again, charging the filter capacitor.

Figure 2 shows the rectification process of the diode.



The applied AC source has two charges — the negative and positive. The formation of the diode depends on the nature of DC output source that can be obtained.

AC VOLTAGE (sine wave)

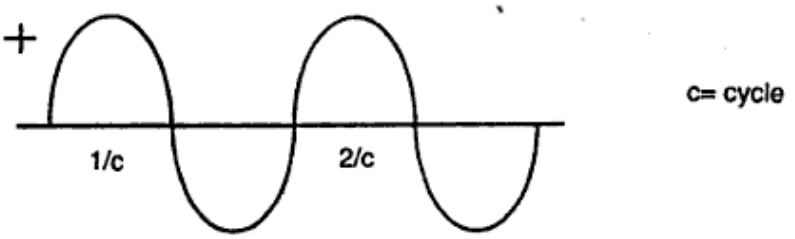
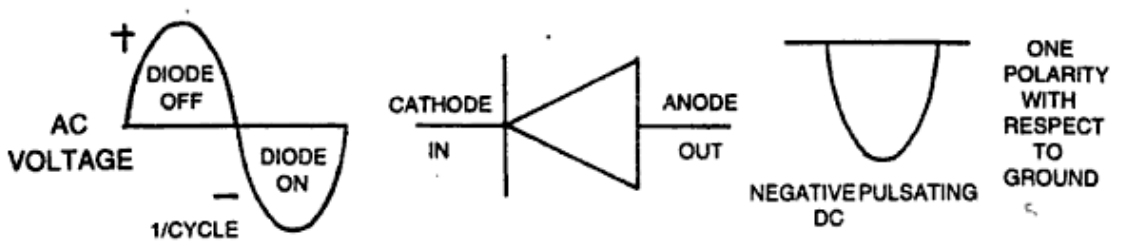


Figure 3 shows the reverse connection of the diode where there is a negative output source with respect to positive ground. In this way, reversing the filter capacitor is necessary.

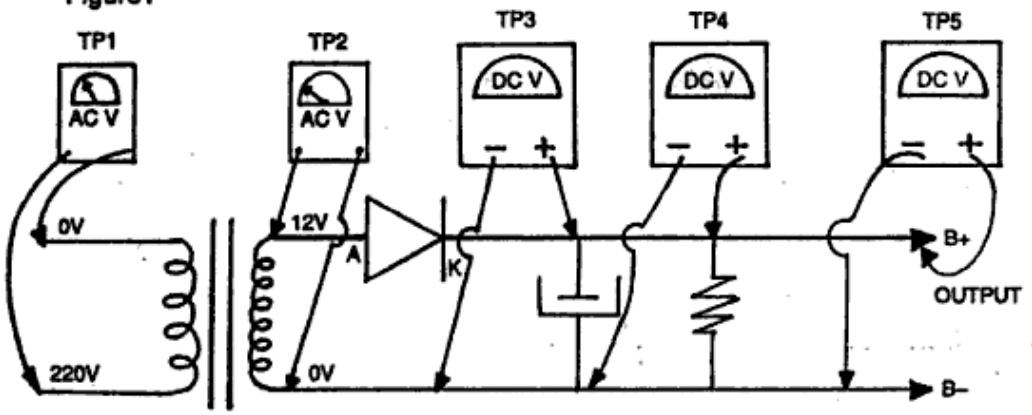


Urheberrechtlich geschütztes Material

VOLTAGE TEST POINTS

In this lesson the proper measurement of voltage is shown in Figure 1. This will guide the reader in circuit analysis through voltage reading.

Figure1



The reader is advised to measure the given test point and fill up the data below.

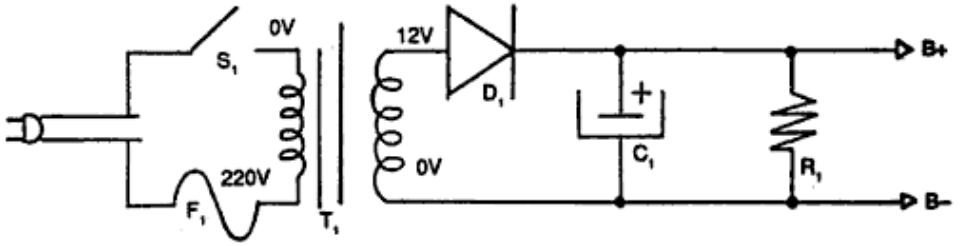
TABLE FOR VOLTAGE MEASUREMENT

	AC		DC	
TP	VOLTAGE	RANGE	VOLTAGE	RANGE
1				
2				
3				
4				
5				
6				
7				
8				

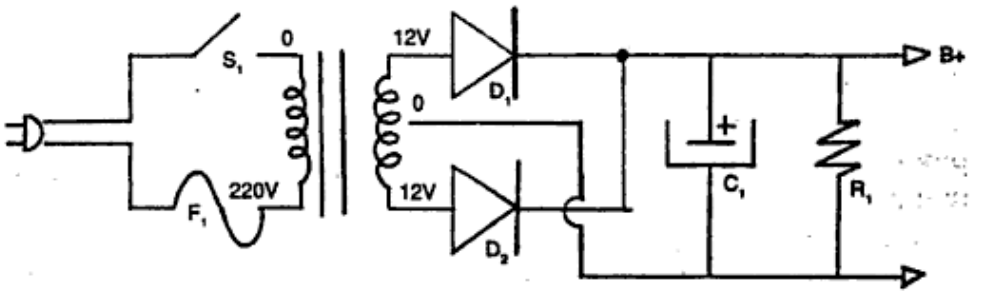
Urheberrechtlich geschütztes Material

TYPES OF POWER SUPPLY

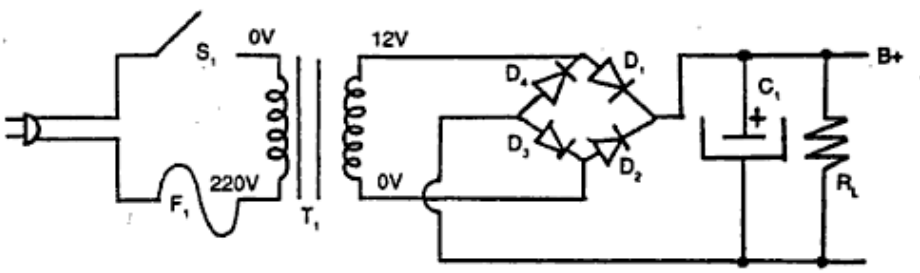
A. HALF WAVE



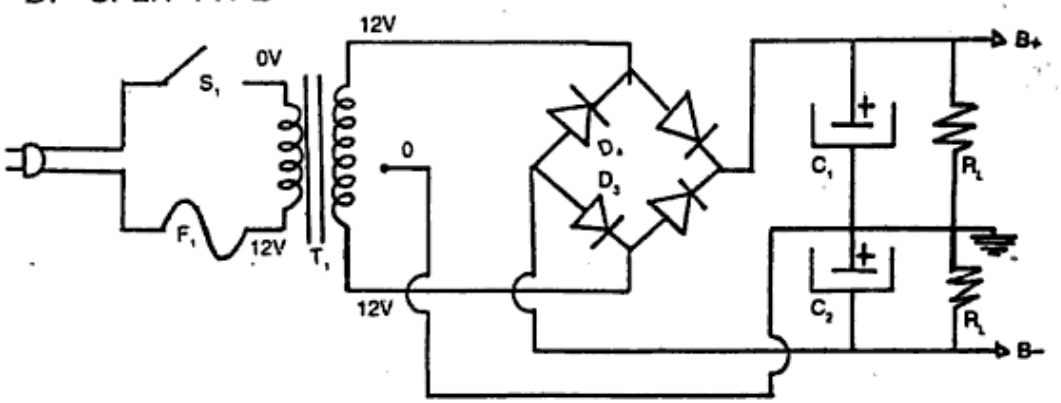
B. FULL WAVE (TWO DIODES)



C. BRIDGE TYPE (FOUR DIODES)



D. SPLIT TYPE



Urheberrechtlich geschütztes Material

TROUBLESHOOTING TIPS

1. Visual check is necessary before conducting in-circuit test to trace out disconnection, shorted wires, burn-out components such as fuse, resistor, and others.

2. Start measuring voltage from the output and going back to the input circuit by the aid of a schematic diagram.

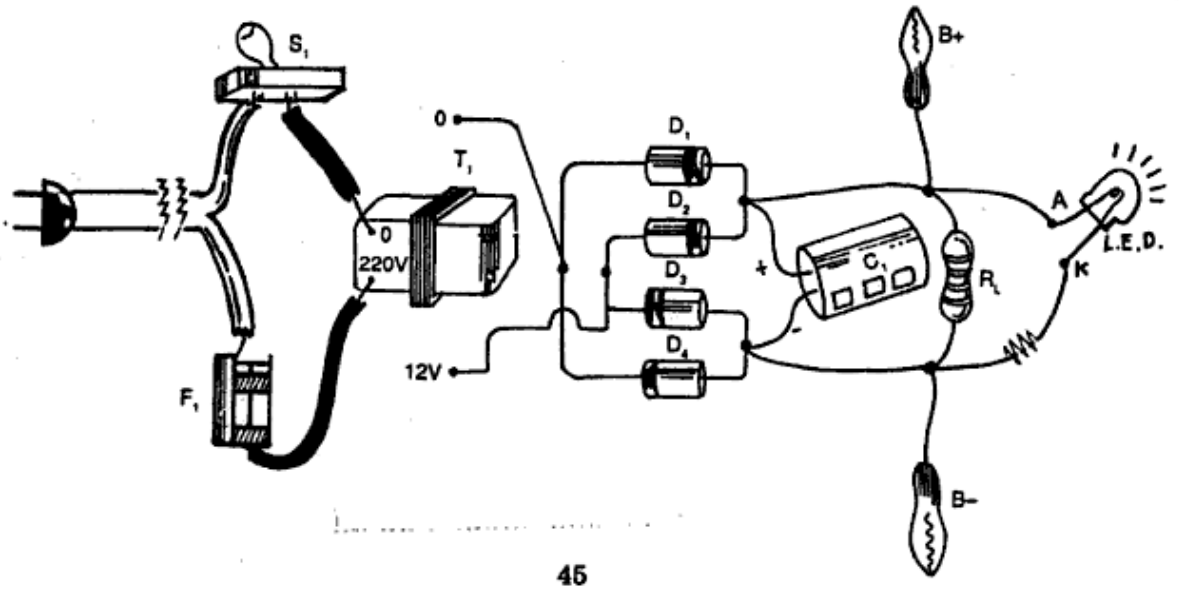
3. Whenever conducting component checking, discharge the filter capacitor first before checking it with the ohmmeter. In circuit test, disconnect one terminal of the component to obtain accurate reading and results. Apply this checking to other components in the PCB.

4. Measure the resistance of the plug that could check the following components at the same time: line plug, fuse, primary of the transformer, switch. If zero resistance is obtained, never apply power to the unit because this will cause a high amount of current that could blow up the fuse. A high resistance must be obtained to have power line in good condition.

5. Be careful in using the proper range before doing any voltage measurement to avoid any damage from the meter.

6. Don't forget to turn off the unit while conducting ohmmeter test.

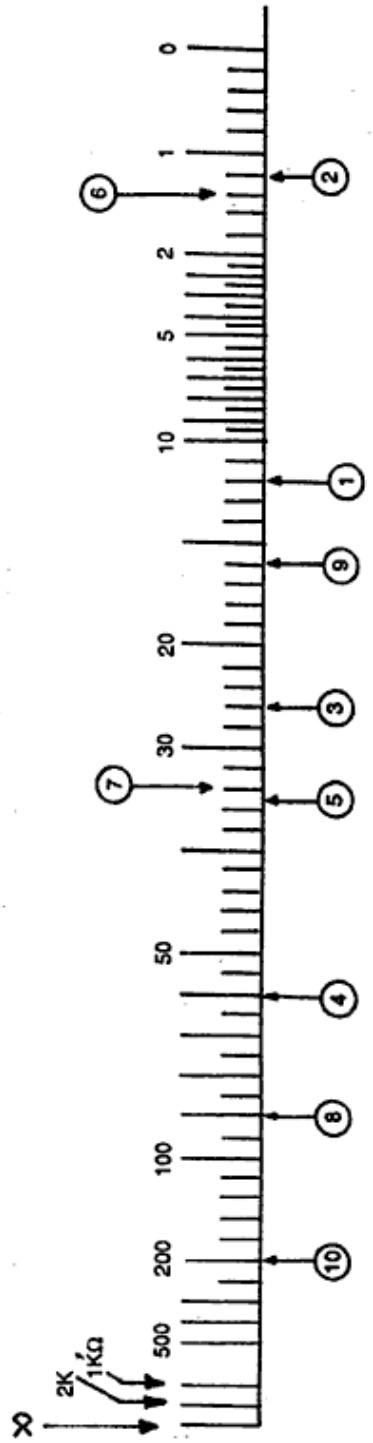
WIRING INSTALLATION AND PARTS



Urheberrechtlich geschütztes Material

ANSWER KEYS

Answers to exercises on page 5



Urheberrechtlich geschütztes Material

Answers to exercises on pages 16 and 17

Figure 1-A

1A. Ans.

1. terminal B of R5
2. terminal B of R7
3. terminal A of C1
4. terminal A of R1
5. terminal A of R3
6. terminal A of R5
7. terminal A of R6

1B. Ans.

1. terminal B of R1
2. terminal A of R2
3. terminal A of C2

Figure 2-B

2A. Ans.

1. terminal A of R9
2. terminal B of C3
3. terminal B of C4
4. terminal B of R7
5. terminal A of R8

2B. Ans.

1. terminal B of R5
2. terminal A of C7
3. terminal B of R1
4. terminal A of R3
5. terminal A of R2
6. terminal B of C5

2C. Ans.

1. terminal A of R1 only .

Urheberrechtlich geschütztes Material

Answers to Seatwork on Page 21

1. 360,000 Ω 5%
2. 530 Ω 10 %
3. 75 Ω 5%
4. 9.2 Ω 10%
5. 830 Ω 10 %

1. BROWN RED RED GOLD
2. GREEN BLACK BROWN SILVER
3. YELLOW VIOLET YELLOW SILVER
4. BROWN BLACK BLACK GOLD
5. ORANGE WHITE BLACK SILVER

Urheberrechtlich geschütztes Material

Project 1 - POWER SUPPLY UNREGULATED

NAME OF STUDENT:

COURSE/SECTION:

DATE:

Materials needed:

T_1	- 1 Amp. Power Transformer (multi-tapped)	
D_1-D_4	- Recrifier Diode	- 1N4001 4pcs.
C_1	- Filter Capacitor	- 2200uf/16V
LED	- LIGHT EMITTING DIODE (Jumbo)	
R_1	- 680 ohms 1/4 Watts	- 1pc.
R_2	- 1 k ohms 1/4 Watts	- 1pc.
Voltage Selector	- 2 Poles 6 positions	- 1pc. or any equivalent
	- 2 meters #22 stranded wire	
	- Line cord and plug	
	- 1 meter soldering lead	
	- Terminal leads 6 post	- 1pc.
	- small alligator clips	- 1-red 1-black

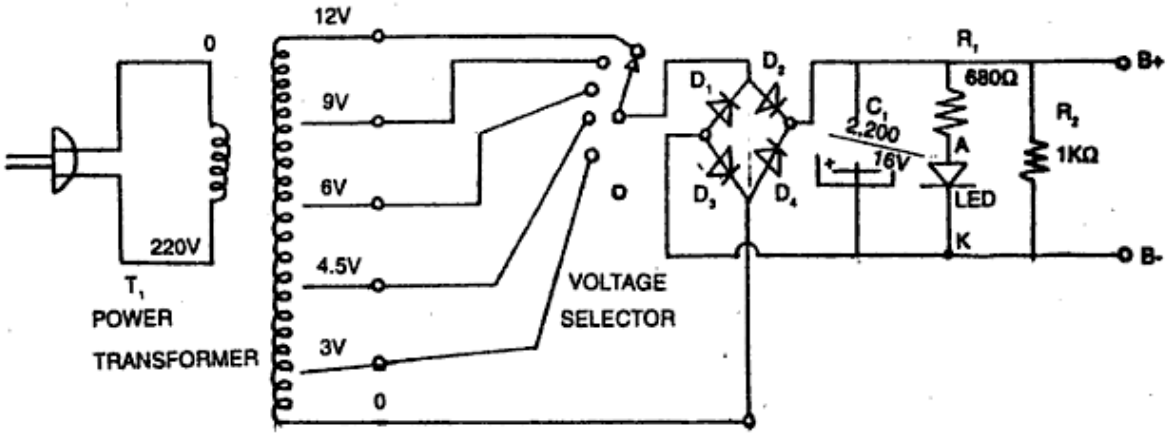
Tools needed:

- V.O.M.
- Soldering Iron 30 Watts
- Long nose
- Side cutter

Urheberrechtlich geschütztes Material

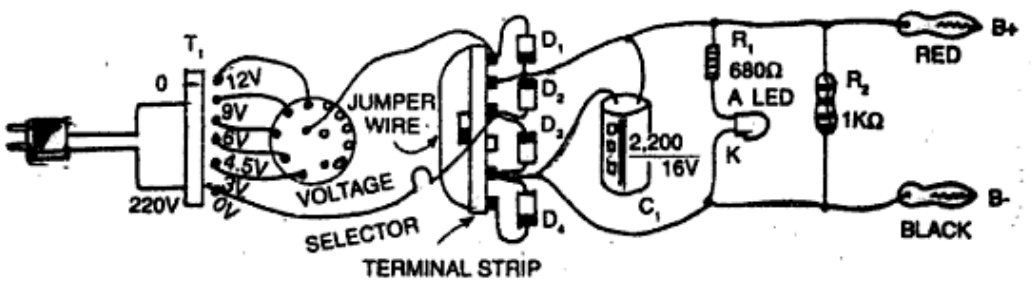
SCHEMATIC DIAGRAM

Figure 1-a



WIRING INSTALLATION

Figure 1-b



Urheberrechtlich geschütztes Material

ABOUT THE AUTHOR

JOE HARVEY FERNANDEZ ALEGADO, born on April 03, 1970, is a Zambalenean from the town of San Narciso,

- finished a technical course with the title of Electronics Technician at the University of Sto. Tomas, Manila, batch 1988-1989,
- is an instructor and Department Head of Computer and Electronics Course at the Philippine Electronics and Computer Institute (PECI) in Baliuag , Bulacan,
- is a Trade Testing Officer in Consumer Electronics accredited by National Manpower and Youth Council (NYMC) in Tabang, Guiguinto, Bulacan
- Coach of the Provincial Skills Olympics in Electronics Trade Area held in Malolos, Bulacan conducted by TESDA.

856 Nicanor Reyes Sr. St.
Tel. Nos. 736-05-67 * 735-13-64
1977 C.M. Recto Avenue
Tel. Nos. 735-55-27 * 735-55-34
Manila, Philippines

MEMBER

ISBN-971-23-2262-9

Urheberrechtlich geschütztes Material